KNOWLEDGE
AN ILLUSTRATED MAGAZINE OF SCIENCE, LITERATURE & ART.

*LONDON: NOVEMBER 1, 1897.*

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## THE APPROACHING SHOWER OF LEONIDS.

By W. F. Denning, F.R.A.S.

THE return of the autumn season, and of that significant epoch at the middle of November which has furnished some of the most brilliant and abundant star-showers on record, will naturally draw a large amount of attention to the phenomena of meteors, and especially to the circumstances affecting the ensuing return of the Leonids. Only seen in their most striking characters at intervals of a generation, it is needless to say that observers are awaiting their reappearance with keen interest, and in full expectancy of witnessing a spectacle sufficiently impressive to form a thrilling experience and a lifelong remembrance.

Brilliant showers of Leonids occurred in 1799, 1833, 1866, 1867, and 1868, and it is fair to assume that the years 1899, 1900, and 1901 will be similarly favoured. The revolution of the swarm round the sun is accomplished in as nearly as possible thirty-three and a third years, so that, since the earliest recorded manifestation of the shower, its displays have recurred in the same years of the century, though the variable conditions of weather, moonlight, and time of *rencontre* of the earth with the densest region of the stream, have affected the character of the exhibitions, and in certain years enabled them to escape detection altogether. There were displays in 902, 1002, 1202, and 1602; also in 1366 and 1866. Others were seen in 931 and 934, to be repeated in 1533 and 1833.

During the next seven or eight years, the middle of November will be sure to furnish an abundance of Leonids, with a maximum either in 1899 or 1900. In 1897 the conditions are not promising as regards a really brilliant return. At the important time the moon will be only a few days past the full, and visible all the time that the Leonid radiant will be above the horizon. In addition to this, it must be remembered that the perihelion passage of Tempel's comet (1866 I.), from which the meteors are derived, and near which they are apparently clustered in their greatest abundance, is not due to return until the spring of 1899, so that the earth will cross the orbit far in front of the comet. In fact, the latter must run its course during another one and a half years before it reaches that point of its orbit which will be nearly intersected by the earth in November, 1897.

Is it likely, therefore, that, at a section of the stream vastly distant on the preceding side of the derivative comet, the meteoric particles are distributed in sufficient numbers to form a numerous display? The answer must be in the affirmative if we are to judge from previous experiences, for it is certain that a host of meteors are in the van as well as the rear of the comet. Tolerably brilliant displays occurred in 1831 and 1864, which nearly correspond with 1897 as regards relative positions of the earth and comet, though in the latter year the conditions are not quite so favourable as in the former.

It may be interesting to make some brief quotations from the observations in 1831 and 1864, as the return of the present year appears likely to form a parallel. Captain Bérard, of the French brig *Loiret*, then off the coast of Spain, near Carthagena, reported to M. Arago as follows: "The 13th of November, 1831, at four o'clock in the morning, the sky being perfectly cloudless and a copious dew falling, we saw a number of shooting stars and luminous meteors of great dimensions. During upwards of three hours more than two per minute were seen." Dr. Wright, of Ohio, U.S.A., also observed a shower of shooting stars on the night following November 12th, 1831. In 1864, on the morning of November 13th, "a grand display of meteors" was observed from the steamship *Ellora*, off Malta. "The watch—an old sailor and an intelligent man—said it was the grandest display he had ever seen, and that the whole watch had been looking at them with delight."

These descriptions justify the inference that many meteors will be seen on the morning of November 14th next. It is true, however, that the forerunners of the dense part of the stream which furnished displays in 1833 and 1866 will envelop the earth for a few hours at about noon on November 14th, and will, therefore, be visible neither in England or America. But immediately outlying the central group, on each side, there appear to be other clusters capable of yielding rich displays, and something of these should be observed both on the mornings of November 14th and 15th. It must be admitted, however, that the past history of the visible appearances of the shower, and of the meteorological and other conditions affecting them, are insufficiently known to warrant any definite conclusion as to the actual strength of the display which will be manifested this year. But as two meteors per minute were counted in 1831, and as "a grand display" was seen in 1864, notwithstanding the presence of a full moon, we may reasonably expect that after the radiant point has reached a fair altitude, at least one meteor per minute will be visible. In fact, the Leonid shower of 1897 ought to quite equal, if not surpass, a rich return of the Perseids of August.

The sky will be light, for the gibbous moon will be

shining in Gemini. On November 14th, at 3 A.M., our satellite will be forty-five degrees west of the Leonid radiant, and on the following morning, at same time, thirty-two degrees west. If, however, the full moon of November 13th, 1864, could not obliterate the display, it is certain that the gibbous moon of 1897 will not succeed in doing so.

As a spectacle for the popular eye it cannot be said that the November meteors of the present year are likely to prove strikingly attractive, though for the astronomical observer they will be sufficiently numerous to incite enthusiasm. The sky should be watched on the mornings of both November 14th and 15th, for the exact time of the best display cannot be indicated with certainty; in fact, we would prefer to depend upon future observations rather than draw unsafe conclusions from a discussion of the imperfect, and somewhat meagre, records of the past. Quite possibly, since 1866, the stream has become distended along the orbit, for there is little doubt that originally compact meteoric groups gradually resolve themselves into continuous rings similar to that of the Perseids, which are prominently visible every year. The Leonids, too, are annually manifested, but with strong periodical maxima, showing that their dispersion is comparatively slight, and that the system still exhibits a high degree of condensation near the parent comet.

Perhaps the following brief synopsis of facts relating to this meteor stream may be useful :—

| | |
|---|---|
| Place of apparent radiant point | R.A. 149° 28′, Dec. + 22° 52′. |
| Approximate star (mag. 5·7) | |
| $\varkappa$ Leonis (Bode) ... ... | „ 149° 10′, „ + 22° 28′ (1890). |
| Radiant point rises ... ... | 10.15 P.M. in N.E. |
| Altitude at midnight, Nov. 14th | 14 degrees in E.N.E. |
| „ „ 3 A.M., „ 15th | 42 „ „ E.S.E. |
| „ „ 6 A.M., „ 15th | 61 „ „ S. by E. |
| Perihelion distance of stream... | 90,000,000 miles. |
| Aphelion „ „ ... | 1,850,000,000 „ |
| Apparent velocity of the meteors | 44 miles per second. |

The shower of Leonids certainly endures during the fortnight from November 7th to 20th, inclusive. In future years it will be important to determine whether the radiant becomes displaced about one degree per day to the eastward similarly to the radiant of the August Perseids. The accumulated observations of past years are not extensive and accurate enough to finally settle the point, for the shower is exceedingly feeble near its opening and closing stages, and requires watching during the whole night before its visible activity can be brought distinctly into evidence.

It is clear, from the great interest which this meteoric shower is attracting, that a very large number of observers will witness it, record its leading features, and describe the most brilliant meteors. It would greatly facilitate the comparison and reduction of meteor paths if observers generally registered them according to the right ascension and declination of their points of appearance and disappearance. To describe an object roughly with reference to its compass bearings and altitudes, or according to its place near prominent stars from or towards which it passed, is not often sufficiently accurate for ascertaining the real path in the atmosphere. A uniform method of tabulating the results in right ascension and declination is more desirable, as conducive to greater accuracy as well as economy of time on the part of those who endeavour to reduce such observations.

In separating the Leonids from meteors belonging to the minor showers of the period and deducing the horary rate of the former, it must be remembered that there are a number of radiants of streak-leaving meteors in the region closely surrounding the sickle of Leo, and that these are very liable to be mistaken for Leonids. The following are some radiant positions of these circum-Leonid showers :—

| R.A. Dec. | R.A. Dec. | R.A. Dec. |
|---|---|---|
| 125°+40° | 141°+27° | 154°+41° |
| 132°+21° | 146°+ 8° | 157°+49° |
| 133°+31° | 148°−12° | 166°+31° |
| 136°+ 8° | 154°+12° | 166°+ 3° |

In 1898 the November meteors will probably be well seen, as the moon will be absent from the sky; and apart from that, the earth will pass through a region of the stream comparatively near the parent comet and presumably rich in meteors. And in 1898 there is also the certain prospect of witnessing a return of the meteors of Biela's comet, for a similar interval will then have elapsed as between the splendid exhibitions of 1872 and 1885; but on the date (November 23rd) of the expected return in 1898 the moon will be approaching the full, and partially interfere with the success of the observations.

## THE BRITISH TRAP-DOOR SPIDER.

By FRED. ENOCK, F.L.S., F.E.S.

IF it comes as news to some of the readers of KNOWLEDGE to hear that we have in Great Britain representatives of trap-door spiders, it is not to be wondered at, considering how very few students of natural history bestow the slightest attention upon spiders, of which we have at least five hundred and twenty different species. This number might be considerably augmented were there more workers in this most interesting branch. The time was when those who ran after butterflies were looked upon as mild lunatics, but happily that idea has passed away in civilized towns—but in the country the line is drawn at collecting spiders, as I can testify from my own experience, for it is a fact that for over three years, whilst living at Woking, I was looked upon by the natives as mad, and called "The Madman," simply because I searched for, and carried home, all kinds of spiders! Even in London a lady once asked me, in the most serious manner, if I "*really* liked spiders"—to which I replied in the affirmative, and received a withering look of pity which quite failed to wither me—so hardened had I become in my love and respect for spiders!

In that most delightful book by the late T. Moggeridge, entitled "Harvesting Ants and Trap-door Spiders," we find that numbers of species of trap-door spiders are to be found in the neighbourhood of Mentone and the South of France. This work is charmingly illustrated with a number of plates showing the various types of "trap-doors" with which the spiders protect the entrance to their nests, which consist of almost vertical burrows about half to one inch in diameter, and of various depths. These holes are lined with silk, the edges bevelled off, and a thick lid, composed of layers of silk, fitted so exactly that when closed down on its marvellous hinge it is most difficult to detect. The resemblance of the trap-door to the surroundings is increased by the spider adding small pieces of moss and lichen to the upper surface of the lid. Unfortunately for science, Mr. Moggeridge died before he had completed his interesting observations, but his work will ever remain as an example to all earnest naturalists who desire to become observers of the habits and economy of minute animals, rather than to amass huge collections of species.

The one representative of trap-door spiders is well figured in Blackwall's "Spiders of Great Britain." It was first discovered by a Mr. Brown, at Hastings, in the year 1856, and received the name of *Atypus sulzeri*. Many

naturalists have visited this locality, but all have failed in finding any specimens—and the male has not yet been discovered.

On January 29th, 1894, Mrs. Enock was successful in re-discovering the locality at Hastings and obtained several specimens of the female—but the male of this type still remains unknown. I have searched for it several times from autumn to spring, but without success, so am inclined to think that it may prove to be of a different species to the Hampstead type, which is the subject of this article.

Mr. Brown, the original discoverer of our British representative, just mentions that his "attention was arrested by seeing something hanging down a bank which looked like the cocoon of some moth."

Never having seen either spider or nest, my only guide was the above description, and for many months I was constantly searching every bank which I happened to pass. I had worked most of the likely lanes and banks in the North of London without success, when I turned my attention to that happy hunting ground, Hampstead Heath, almost every inch of which I walked and worked over. Until I had convinced the constables that I was not an escaped lunatic, they continued to watch me day after day—much to my amusement and occasional annoyance. However, all this came to an end before long, for in one part of the Heath at last "my attention was arrested by the sight of something hanging down, which looked like the cocoon of some moth."

Fig. 1.—Section of Nest of a British Trap-door Spider.

But now, with the game before my eyes, I might not dig it up, as no one at Hampstead was allowed "to disturb the soil." However, I had a friend with me, who kindly covered my attack, so that in about an hour I had managed to dig up a fine nest, containing a large female trap-door spider—which was quickly transferred to a tin box, and the disturbed soil nicely smoothed over, without further trouble or interference from anyone. At a future visit I was enabled to dig up several other specimens, some of which I sent to the Rev. O. Pickard-Cambridge, who kindly informed me that they could not be identified "without the mature male."

Fig. 1 represents the nest of the British trap-door spider, shown in section in the sandbank. The hole is about five-eighths of an inch in diameter, and the depth varies from nine to fifteen inches, running backward and downward at an angle of about thirty degrees. This burrow is the work of many years: the first one, excavated by the young spiderling twelve hours or so after it has left the maternal home, being but one inch deep by one-sixteenth of an inch in diameter.

As soon as the spider has determined upon a site for its dwelling, it proceeds to excavate a hollow by using its jaws, carrying the sand between them until it has burrowed down a sufficient depth. It then commences to line the inside with silk, which it weaves all over the sides until the top is reached, when it continues to weave a silken tube, carrying it up against the side of the bank and attaching the converging ends of the silk to some grass stem or leaf. When this is accomplished the spider proceeds to the lower end of the burrow, from which she takes up a mouthful of sand, and reversing her position she reascends with her load. Arrived at the aërial portion of the nest the spider drives both of its long fangs through the silken structure, and then, pressing the sand through the meshes against the fangs, it "pit-a-pats" with its feet on the inside, and thus causes the sand to adhere to the outside. This is repeated until the whole of the aërial portion is sanded all over, the resemblance to its environment being so exact that it is not an easy object to detect at a glance.

Fig. 2.—British Trap-door Spider (Female).

As soon as the spider has finished sanding the outside she fixes silk to the inside of the aërial part, then walks down to the bottom of the burrow, and quietly rests with the silken cords stretched from the tip of her spinneret to the top of the burrow. These threads form a sort of telephonic communication—the slightest movement on the outside setting them in vibration, and intimating a visitor outside.

Fig. 2 delineates the female trap-door spider, which, when full grown, is about five-eighths of an inch long, and the same across the legs. A glance reveals the fact that this is a very powerful spider, but unfitted for active climbing, which is not indulged in at any time. The legs are well formed and developed for assisting in the removal of the sand, though the principal part of this operation is performed by the huge jaws, which are most powerful organs, each being terminated by a long and slightly curved fang. Anyone who has examined the common garden spider will know that it seizes its prey by opening its jaws *laterally* (*see* Fig. 4), whereas in *Atypus* the jaws open *vertically* (*see* Fig. 5). The reason for this difference is apparent when we consider the different circumstances (described in the second part of this paper) under which the trap-door spider obtains its food.

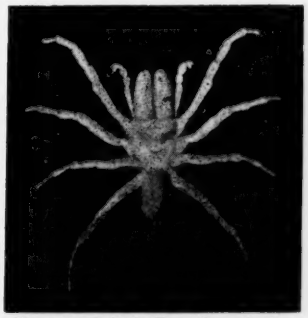

Fig. 3.—British Trap-door Spider (Male).

Fig. 3 is a presentment of the male trap-door spider, a very different animal to the female, who never leaves her nest unless compelled by force to do so.

Though one or two males had been found in odd places since 1857, no record of identification had been made; and as these males had not been found in nests or tubes, it was taken for

granted that they did not make any—but *why* not I failed to see or to be convinced. My own opinion was that the male did live in a tube during its younger days, and to prove this to be a fact was a long and arduous task carried on by day and night at Hampstead, to which Heath I made no less than twenty-nine journeys before I was successful. Just twenty years ago this month (October) I once more made a tour of the colony spread over the Heath. I had carefully examined some nests which I had marked and examined many, many times during the past years. One, upon which I had previously looked with suspicion, now caught my attention, for at the apex was an aperture with the edges of the silk turned outwards, from which I thought something had gone out. I promptly set to work digging the tube out of the sand. The fact that it was an exceedingly delicate one made the task difficult, but at last I had the pleasure of removing it successfully, being careful not to break the sand away from the bottom, for if my opinion was correct I expected to find the old clothes or skin of the spider left behind, and in these old clothes would be found the proof as to the sex of the late owner. I at once saw that the tube was empty, so, carefully boxing it, I turned my steps homeward, where I soon had the microscope out for the purpose of searching over the *débris* from the ruptured tube. The old skin was tolerably perfect in the main parts, but the organs which I desired to find were the minute terminal points of the palpi, which every arachnologist knows are different to those of the female. After a close examination of the loose sand at the bottom of the nest, I found the object of my search, viz., *both* terminal clubs of the immature *male* trap-door spider, thus proving that it does make a tube as well as the female—also

FIG. 4.—Jaws of Common Garden Spider (opening laterally).

FIG. 5.—Jaws of British Trap-door Spider (opening vertically).

that the mature spider was somewhere about Hampstead Heath. The next day I was again found wandering about, with my eyes and nose close to the ground, peering behind and under every likely and unlikely gorse bush, and any stunted plant which I thought might afford shelter for the wandering male.

During my search I passed many nests whose outward appearance had not altered since my previous visit. At last I noticed a large one, in the aërial portion of which was a big rent, with the edges turned in. An hour and a half of steady digging, and this tube with its contents was safely removed. I noticed that something was moving up the inside, and when it reached the rent I saw that it was a large female, which I at once boxed; then, on examining the lower part of the nest, I saw what I at first sight thought an old skin, but to my surprise and great joy it moved, spread its legs, and walked out, revealing itself to be the long-searched-for mature *male* trap-door spider. I forwarded both male and female spiders to the Rev. O. Pickard-Cambridge, who informed me that they were, without doubt, the *Atypus piceus* of Sulzer.

Since this capture (1877) and settlement of the name, I have steadily worked out the life history of this most interesting spider, and in the next number of KNOWLEDGE I shall give a detailed account of its structure, life, and habits, which I am able to do after years of close observation of many individuals.

*(To be continued.)*

## THE MYSTIC NUMBER THREE.

THE number three possesses so many peculiar properties that it is no matter of surprise that the ancients came to look upon it with a sense of profound admiration. In a paper lately published by the Asiatic Society of Bengal, Mr. S. C. Laharry describes a few mysterious and unaccountable properties of the number; and in themselves they are sufficient to surround it with an atmosphere of superstition. To begin with, when any number is multiplied by three or any multiple of three, as six, nine, twelve, etc., the separate figures in the result, if added together, give a total of three, or a multiple of three, thus :—

| | | | | | |
|---|---|---|---|---|---|
| 4 | multiplied by | 3 | gives 12, and | 1+2 | = 3. |
| 5 | ,, | 3 | ,, 15, ,, | 1+5 | = 6. |
| 17 | ,, | 9 | ,, 153, ,, | 1+5+3 | = 9. |
| 22 | ,, | 12 | ,, 264, ,, | 2+6+4 | =12. |

Another noteworthy property of the number is that when thirty-seven is multiplied by three, or any multiple of it up to nine times—that is, twenty-seven—the result consists of three same figures, thus :—

| | | | | |
|---|---|---|---|---|
| 37 | multiplied by | 3 | gives | 111. |
| 37 | ,, | 6 | ,, | 222. |
| 37 | ,, | 9 | ,, | 333. |
| 37 | ,, | 12 | ,, | 444. |

Peculiarities of this kind make three a remarkable digit, even mathematicians admit, so it is not surprising that the number plays an important part in traditions everywhere, but more especially in Asiatic countries.

In the English language, expressions in which the number three occurs, such as "Three cheers," "Sisters three," "Three sheets to the wind," "Three estates of the realm," and the like, are very common. The Chinese assigned mysterious properties to the number, and founded upon it their famous Triad Society, the management of which is vested in three chiefs or Elder Brothers; and the nations of Rome, Greece, Egypt, and India attributed a triplicity to the deities of old.

That the Druids favoured the number three is believed by Mr. Laharry to be shown by the facts that there were three degrees in Druidism—(1) Bards, (2) Prophets, and (3) Druids, or sanctified authorities—and that the colours they used were white, blue, and green, emblematical of light, truth, and hope. Under each Arch-Druid there was a trinity of ministers. The Egyptians had their trinity in Osiris, Isis, and Horus; in Scandinavia the trinity of deities consisted of Odin, Vile, and Ve; while the Gothic triad was composed of Woden, Frigga, and Thor. Ancient Greece honoured Zeus, Poseidon, and Hades; while ancient Rome was not content with a single trinity—Jupiter, Neptune, and Pluto—but four times three deities presided over their spiritual and temporal rites.

The Hindu trinity consists of Brahma, Visnu, Çiva—

representing creation, preservation, and destruction; and expressions like the "three Fates," the "three Muses," the "three Furies," and the "three Graces" are all found in the Hindu vocabulary. The primitive Aryans accorded a kind of pre-eminence to triads of natural objects, such as the sky, atmosphere, and sun; and give many proofs of their preference to group the objects of their adoration in triple combinations, to which a sacred significance not unmixed with superstition was attached by the primitive races of the East. The Mohammedans have also shown that they do not look with disfavour upon the triple arrangement of everything material. All these instances and many others brought together by Mr. Laharry, when considered with the Trinity of the Christian faith, show that the mystic number three has had a very distinct influence upon the thoughts of the nations of the world.

## PHOTOGRAPHY IN ILLUSTRATION.

By H. SNOWDEN WARD, F.R.P.S., *Editor of "The Photogram."*

So steady and so evenly progressive has been the growth of photographic illustration in the past few years, that few realize what an important—what a revolutionary—power photography has been. If I had but time to sketch the mere romance of the subject it would make a fascinating Christmas magazine article even for the "general reader." For the relentless march of progress has meant suffering, stern hardship, and even death to some of those craftsmen whose crafts have been supplanted; and even the votaries of the photo processes themselves—the men who have worked out the processes by which we are enabled to lavishly illustrate our penny papers—have had amongst their ranks as real martyrs as ever suffered for religious zeal. Death from practical starvation, penniless widows and orphans, loss of reason and confinement in the madhouse—all these have been amongst the rewards given by a grateful world to the men who have laboured to increase man's knowledge and man's power, even in the unromantic realm of photographic illustration.

Perhaps this is a little beside my proper subject, but all along the line of the history are constant glimpses of romance. In the broad lines we may point to photo-mechanical processes as having, first, killed the old school of wood engraving. Such "woodpeckers" as still remain with us mostly earn a curtailed and often precarious income by engraving mechanical and engineering subjects, catalogue illustrations for rough printing, poster blocks, and other inartistic work. Much the same fate, though even more completely, has befallen the steel-plate and copper-plate engravers, whose work in the reproduction of pictures cannot be lost without regret. Even the illustrators, the black-and-white artists, have found their conditions greatly changed by "process," for since the half-tone can make passable reproductions of poor photographic originals, many of the draughtsmen find their work no longer in demand, while others have been forced to completely alter their methods.

In the great industry of paper making, too, "process" has worked nothing less than a revolution, based on the demand of half-tone printers for highly finished and clay-faced papers—of which I will say more anon.

Most photo-mechanical processes are based on the fact that certain colloid substances, gelatines, gums, etc., when treated with a bichromate salt, become sensitive to light in a peculiar way. Of course, everyone knows that certain silver salts, when suspended in gelatine or albumen and laid upon paper, have such a sensitiveness to light that upon exposure to it they change from a practically white colour to a chocolate-brown or black. This is the basis of the ordinary photographic printing process. The bichromated surfaces, on the other hand, though their colour changes but little, go through considerable changes in other ways. For instance, a bichromated gelatine is soluble in water before exposure to light, but the light's action renders it insoluble; and on this fact are based almost the whole of the photo-mechanical processes. Another action upon bichromated surfaces is that what will remain soft and "tacky" in the dark, will become hard and horn-like under exposure to light. As these changes take place in proportion to the amount of light falling upon the sensitive surface, it is obvious that by using a photographic negative as a shield, parts of the surface (under the densest parts of the negative) may be left perfectly soluble; parts (under the semi-transparent parts of the negative) will be less soluble; and parts (where the transparent portion of the negative allows the light to act fully) will be perfectly insoluble. This is the basis of photo-mechanical work.

The processes may be divided into three chief classes:—A, relief printing, as in half-tone and line zincography; B, surface printing, as in collotype and photo-lithography; and C, intaglio printing, as in photo-aquatint, photogravure, and Woodburytype. Of the applications of the work to decorative purposes—to pottery decoration, to the etching and damascening of metals, to the printing of tiles, to the production of plaster and other reliefs and transparencies—I must say nothing in detail, though this branch of the subject is extremely fascinating.

The relief-printing processes of half-tone and line zincography are by far the most generally used, because by their means are produced printing blocks which may be printed in the letterpress printing machine, in the same forme with ordinary type. The other processes, which cannot be printed on the letterpress machine, are only suitable for separate illustrations, supplements, frontispieces, etc. In letterpress printing the printing surface of the type and blocks consists of lines and dots of metal, all on one level, while the whites are represented by depressions in the metal. The ink is applied to the raised surface, and does not enter the depressions, so that when the paper is pressed against the forme the ink from the raised surface makes the print. In this method all parts are equally inked, so that any effect of half-tone or gradation in a picture must be obtained by varying the size of the lines and dots in relation to the spaces between them. In line zincography this variation is made by the artist, who produces a drawing in strong black ink on white paper, usually making the drawing about a third larger than the printed picture is intended to be, because the fineness and crispness of the lines is increased by camera reduction.

In line zincography this original drawing is placed upon an easel, usually illuminated by electric light. A camera is placed before it, and the image focussed and arranged so as to fall upon the sensitive plate in the size intended for the finished block. After exposure, the plate is developed, and a negative is obtained in which the white spaces of the picture are represented by a dense opaque deposit of silver, while the lines are transparent and clear.

This negative is then forced into contact with a sheet of metal (usually zinc), the face of which is coated with a sensitive film, somewhat similar to those indicated in an earlier paragraph. The light passing to this film through the transparent lines of the negative, produces, under them, insoluble lines of film. When the exposure to light has lasted long enough, the coated metal plate is taken from the

XUM

negative and its coating is washed away, except where the insoluble lines are found. In this state it is (theoretically) ready to be placed in a bath of acid, which would eat away the exposed portions of the metal, leaving in relief the lines protected by the insoluble film, which would protect the metal. Practically, it is necessary that the power of these lines to resist the acid should be reinforced by coating them with a fatty ink, and the application of such ink (to protect the sides of the lines as the acid eats down) is usually repeated several times during the etching.

When the etching is deep enough, the metal plate is cleaned from its protective coating and mounted upon a wood block to raise it to the thickness of ordinary printing type.

In the half-tone process we have to face the difficulty that the originals are not broken up into dot or line, but consist of flat gradations of tint, as in photograms or wash drawings. In this case, if a negative were made as above mentioned, it would consist of dense parts, transparent parts, and every possible grade of opacity between. The coating on the metal plate, after printing, would have perfectly soluble and perfectly insoluble parts, with every gradation between, and in the washing off would come patchy and totally unsatisfactory. Altogether, the resulting block would be one from which no printer could make a print fit to be seen. The overcoming of this difficulty has employed the thoughts of many able men, whose efforts have resulted in a satisfactory process which is now in universal use.

Essentially, the half-tone process is the same as the line process just described, except in the matter of the negative. In making this, the original to be reproduced is fixed on its easel, and the camera is arranged very much as in the line process. Immediately in front of the sensitive plate, however, is placed a glass plate ruled with fine cross-lines, after the fashion of a micrometer grating. This is called the cross-line screen, and its action is not nearly so obvious as might at first be supposed. In fact, the screen was in everyday use by hundreds of firms and thousands of operators for some years before its real action was known. To explain that action would take more space than is at my command, and would lead into somewhat abstruse optical and mathematical details. Suffice it to say that the practical result is that the high lights of the resulting block consist of very fine dots, surrounded by white; while the shadows are represented by larger dots with but small spaces between them, or even joined together to form solid blacks. This effect will be seen by examining any print from a half-tone block (for instance, those on page 269 of this journal), and is all the more clear if a magnifying glass is used.

As it is necessary that a fine "screen" should be used, to make fine dots, if the picture is to show any delicate gradation and detail, it follows that the metal cannot be etched very deeply between the dots, and this shallowness of the half-tone block is its great fault in the eyes of the printer. It necessitates the use of a very fine stiff ink, and hard unbroken inking rollers, or the fine shallow spaces between the dots will fill with ink and the resulting print will be spotty. The paper, too, must be fairly stiff, or it will be pressed into the shallow spaces; and it must not be fluffy, or the surface hairs will be pulled off by the stiff ink, and rolled by the inking rollers into the spaces of the block. Before the introduction of these fine blocks it was the custom of printers to always work with their paper damp, in order that it might take the inked impression more kindly, and with half-tone blocks this "wet" printing is impossible. Curiously enough, for our knowledge of the "dry" printing method, and largely for the present position of illustrated journalism, we are indebted to the American War of the Rebellion.

The "dry" printing was really first worked out by some of the army printers, in times when water and the facilities for damping paper were scarce. Working against their difficulties, and modifying their ink and their inking to make the best of a bad job, they found that, before long, they were able to make even better results with dry than with damp printing. Once this was established, it became possible to improve the face of the paper by rolling and by other methods, giving it a smooth surface that would be ruined by damp printing, but that rendered the dry impression immensely more fine than any damp impression. Before long, dry printing and the highly faced papers were in use in the States for all fine work; and when half-tone began to be used, the American printers, as a whole, were much better prepared to tackle it than were the British, who had less generally adopted dry printing. Hence, the American half-tone printing, and the American manufacture of papers and inks for the work, have been, until quite recently, far ahead of anything European.

I have dwelt at some length on these relief-printing processes because of their great importance, and have now only space for the briefest possible description of collotype printing,* with which, however, photo-lithography is closely allied. In this process a negative is used, somewhat as before, but the surface for eventually printing from is plate glass (usually) coated with bichromated gelatine. After this has been exposed under the negative, the gelatine which remains soluble is not removed, but simply has the bichromate soaked out of it. The plate then remains covered with gelatine, part of which (the whites of the picture) is water absorbent, while the rest, for printing the shadows, is hard and dry. An inking roller charged with greasy ink is passed over the whole surface, and, since the grease is repelled by water, the ink only adheres to the dry parts of the film. The paper is brought in contact with this and run through a lithographic press, and the picture appears.

It is impossible to deal with photo-aquatint, photogravure, Woodburytype, and other kindred processes in the present space, in which I have merely attempted an outline of the leading photo-mechanical methods. My hope is that the outline may be sufficiently clear to give readers some notion of how their pictures are produced.

## THE FLIGHT OF A SEED.

By Rev. ALEX. S. WILSON, M.A., B.Sc.

THE higher plants are fixed throughout life to one spot; they have no power of locomotion. Nature has so far made amends by providing the seeds of many species with appendages of various kinds which greatly facilitate their dispersion. The hairs or plumes with which so many seeds are furnished constitute a very effectual appliance of this kind. Hairs, if horizontal, prevent a seed from falling quickly; if vertical, they act like sails, so that the seed is impelled rapidly before the wind. The presence of such appendages often entails other related adaptations, very much on the principle that a man who has a horse also requires harness, and in some of these auxiliary contrivances nature seems to have taxed her ingenuity to the utmost to secure for each seed a fair chance of development. Sometimes the entire outer surface of the seed is beset with long silky hairs, as in the cotton-plant (*Gossypium*). In the allied *Sterculiaceæ*, or silk-cotton order, several genera, including

* *See also* "The Collotype Process and Photo-Engraving," by A. C. Ranyard. (KNOWLEDGE, February, 1890.)

*Bombax*, *Eriodendron*, etc., have the same peculiarity. More frequently, however, the hairs are confined to one end of the seed and form a tuft, as in the willow and poplar, where they grow from the stalk at the base of the seed and constitute an arillus. *Asclepia* and *Epilobium* have an arillode; the hairs spring from the summit of the seed where the micropyle or little opening is situated. *Hibiscus* has seeds tufted at both ends. In species of *Anemone*, *Clematis*, and *Geum*, and in the plume nutmeg (*Atherosperma*), hairs are developed from the wall of the fruit; they arise from the flower-stalk in the cotton-grass (*Eriophorum*), so abundant on all our moors. The pappus or hairs attached to the seed-like achenes of *Compositæ* and *Valerianaceæ* probably belong to the calyx. Pappus exhibits considerable variety: in the thistle and hawk-weed it is feathery; in the hawk's-beard and sow-thistle the hairs are simple and undivided; in the goat's-beard and dandelion the pappus is stalked, while that of the hawk-weed is sessile. These and other minor differences are probably not without physiological significance; indeed the thistle, dandelion, and many other composites have most exquisite contrivances for securing the proper development and exposure of the pappus hairs. For the present, however, we shall leave out of account pappus and other appendages developed on fruits, and confine our attention exclusively to cases where the hairs arise on the seed itself.

Where seeds are not provided with hairs or other appendages, their connection with the placenta on which they grow is usually severed before the seed-vessel opens; lying loose and detached in the interior, they are scattered by the bursting of the ripened capsule. This arrangement is quite unsuitable in the case of plumed seeds. The plumes have no room to develop and unfold in the limited space within the seed-vessel, and were they at once scattered by the sudden opening of the capsule, their damp matted hairs would be of little or no use for the purpose for which they are intended. The hairs require to be dried and disentangled; for this purpose it is essential that the air have free access to them. Between the opening of the capsule and the detaching and discharge of the seeds, some little time must elapse to admit of the proper expansion and desiccation of the plumes; the seeds must be retained in the nest, so to speak, until they are fully fledged. It is clearly an advantage as regards dissemination that the seed should remain attached to the parent plant until it has become fully equipped for flight. This is usually attained by the seed remaining attached to the placenta by its funiculus, which does not give way until the aril is perfectly expanded; but in the willow-herb the retention of the seed while its pinions are maturing is effected in a still more curious way. A common weed in gardens and hedgerows, the willow-herb (*Epilobium montanum*), possesses as remarkable an arrangement for dispersion as is to be found in the British flora. To the manner in which the fruit of this plant, in conjunction with its arillate seed, has become specialized for the promotion of dispersion we wish now more particularly to ask the reader's attention. The small pink flowers of the willow-herb are too well known to require description; they have four parts in each whorl, as the rule is in the fuchsia order to which it belongs.

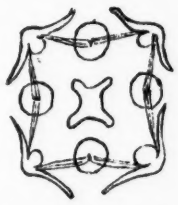

FIG. I.—Transverse Section of Opening Capsule, showing how the Seeds are attached to the Valves by their Hairs. Much magnified.

The enchanter's nightshade (*Circæa lutetiana*) and the evening primrose (*Œnothera*) also belong to the *Onagraceæ*. Other allied species of *Epilobium* are the French willow or rosebay, and the great hairy willow-herb; these have handsome flowers compared with their humbler relative.

The ovary of the willow-herb is situated below the flower, and develops into a long narrow pod, very little thicker than the flower-stalk. On a transverse section it is seen to consist of four cells with the seeds attached in the inner angles at the centre. Each cell of the ovary is a long narrow chamber, containing a single vertical

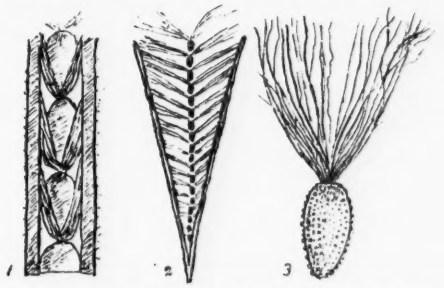


FIG. II.—1. Longitudinal Section through Loculus of Willow-herb Fruit, showing the parting of the Arillodes. 2. Two Valves with Seeds suspended by Hairs. 3. Seed with Arillode. Magnified.

column of seeds closely packed one on the top of the other. The arillode of hairs on each seed is parted in the middle, the two portions being crushed between the next overlying seed and the walls of the loculus, as shown in Fig. II. 1. The hairs are four or five times as long as the seed itself, and, at their upper extremities, are caught and firmly clasped by the edges of the folded carpels (Fig. I.). The narrow, elongated capsule, when ripe, splits into four very slender splint-like valves, two or three inches in length. The fruit first opens at the top; the separation of the valves is very gradual; as they dry they diverge from the central axis and from each other, and curve outwards, but remain united by their bases until long after all the seeds have been discharged (Fig. III.). But when the capsule splits in this way, the seeds, though detached from the placenta, do not fall out; they are tethered by their hairs to the four slender segments into which the capsule has separated. Each pair of valves resembles the letter V, the seeds being hung between its two arms (Fig. II. 2). This cresset-like arrangement might roughly be compared to four ladders set in a square. On the middle of each rung of the ladders a seed is perched, the rungs themselves being the hairs of the arillode, which in each seed is parted in the middle, one half being attached to one valve and the other half to the next. The manner in which the seeds are superimposed on one another gives to each of the four vertical series a herring-bone appearance. One effect of this curious arrangement is that as the valves curl in drying, and become more and more divergent, each seed in turn is lifted up out of the loculus and is at the same time pulled away from the central axis. The uppermost seeds in each row have their hairs tightly stretched, but with the ends still firmly grasped in the grooved valves. This condition continues some little time, but as the hairs get drier they are one by one released from the clutch of the carpels. The latter gradually slacken their hold, and the seed slowly spreads out its little flossy fan-like arillode. The topmost seed is at length held fast by a single hair; finally it shakes itself free and escapes. The others in each of the four series follow in regular succession.

XUM

One very manifest advantage here is the gradual distribution of the seeds; the members of each series are discharged at intervals—not simultaneously—whereby more widespread distribution is likely to be attained. When a gardener is sowing small seeds in drills he naturally takes a pinch between his thumb and two first fingers; straightening the thumb and fingers slightly causes them to separate a little at their tips, so that the seeds fall with sufficient slowness for his purpose. The opening of the seed-vessel of *Epilobium* takes place after the same fashion; its slender valves, slowly curling outwards, act in a manner precisely analogous to the gardener's thumb and fingers and regulate the sowing of the willow-herb. It is conceivable that the same end might have been more simply attained by the valves falling apart, and by the seeds retaining their connection with the placenta until their arillodes were perfected. But the seeds in each row are so close, and the four parallel rows themselves are so close, that the hairs on none of the seeds would have had sufficient room to expand, either in a horizontal or in a vertical direction. Now the peculiar manner in which this fruit opens not only insures the retention of the seeds for a sufficient length of time after the opening of the capsule to admit of the proper drying of the hairs, but also secures additional space both horizontally and vertically. Not only are the four rows separated, but the individual seeds in each row are placed at a greater distance from each other, whereby a free circulation of air between them becomes possible.

Fig. III.—Capsule of the Willow-herb, opening.

The long slender valves are highly hygroscopic, and as they dry become more and more curved, so much so that a plant of *Epilobium* after its seeds are shed presents quite a tangle of curled fibres, especially if the atmosphere be dry. So marked is the hygroscopic property of these segments of the fruit that even after they have bent almost into a circle, if we moisten them they again become perfectly straight. This property is doubtless of use, since to some extent it enables a capsule which has begun to open to close up again should the weather become unfavourable, so that the seeds are protected from rain, which would greatly interfere with the development of their arillodes.

Possibly the special provisions for dispersion in the fruit of the willow-herb may have been rendered necessary on account of the shape of the capsule being ill adapted otherwise to promote dispersion. Be this as it may, we have in the willow-herb a capsular fruit which has become modified in a singularly striking manner to assist in the dispersion of arillate seeds. *Epilobium* literally hangs out its seeds to dry. There are other cases in which something of the same kind occurs. When the capsule of *Magnolia* opens, its seed is thrown out, but remains attached by its long slender funiculus. The seed of the magnolia is succulent and coloured; the object of hanging it out in this fashion is evidently to attract the notice of birds, through whose agency such seeds are disseminated. *Roxburgia* presents a closer analogy to *Epilobium;* its tufted seed is hung out until torn off by the wind. But neither of these examples shows the elaborate combination of correlated adaptations co-operating to one end which we have been endeavouring to describe.

## British Ornithological Notes.

*Conducted by* Harry F. Witherby, f.z.s., m.b.o.u.

Cuckoo and Hedge Sparrow.—Cuckoo's egg found in hedge sparrow's nest, May 27th, 1897. May 31st, young cuckoo and three young hedge sparrows in nest, the latter much larger than their foster-brother, suggesting that the cuckoo had been hatched later. Unfortunately, for fear of disturbing the foster-mother on the nest, I had not been there between the 27th and the 31st. On June 3rd the cuckoo was still blind; the young hedge sparrows had their eyes open. June 5th, only the young cuckoo in the nest; one dead hedge sparrow found among the nettles and tangled brambles close by. I could not search thoroughly for the other two without disturbing the nest. The length of the cuckoo from beak to tail was now two and three-quarter inches; the hedge sparrow measured nearly the same, but its bulk was decidedly greater. The cuckoo was still blind. June 6th, when I put him in the palm of my hand, he was unable to straighten his legs. His back was only three-quarters of an inch above my hand. The nest was one and a-half inches deep; the thickness of the walls, which were nearly flat at the top, was one and three-eighths of an inch. How had the young hedge sparrows been ejected? It is not possible that the young cuckoo had achieved this. It is possible that some human hand may have flung them out, but this seems unlikely. Had the mother cuckoo visited her offspring and done for him what he was unable to do? In colour he was, at first, a bright pink; of down there was not a sign on his body. But gradually his skin became almost black. The hollow in his back, just anterior to the pelvis, was very marked from the first. On June 8th it had filled up to a great extent. On June 10th the cuckoo had been taken from the nest.—F. W. Headley, Haileybury College.

Kites in Wales.—I have paid two short visits this summer to the remote district in South Wales where I have known kites to exist for the last thirty years. I am glad to say they are still there, though on each occasion they only appeared once. The first time, early in July, I unluckily missed them myself; but my companion, who was fishing separately, had a very fine view of a pair, and watched them in their spiral ascent to an almost incredible height, as I have described them doing in the second chapter of "Summer Studies of Birds and Books." On the second visit I saw one only, which crossed a broad valley apparently without a single motion of the wings. Whether their eggs have been taken this year I cannot be sure, but I have some reason to believe so. In order to protect these grand birds efficiently, it is necessary that three counties should combine, viz., Carmarthenshire, Cardiganshire, and Breconshire. The gain would be immense, for buzzards and ravens are still fairly common in the district, and little harm is done by any of them, unless it be to some extent by ravens in the lambing season.—W. Warde Fowler, Chipping Norton.

[The eggs of the kite are protected by law in Breconshire, but the County Councils of Carmarthenshire and Cardiganshire have done nothing to protect either the eggs or the birds.—H.F.W.]

Isabelline Variety of the Meadow Pipit in Herefordshire.—My brother-in-law, Capt. J. C. Tyrwhitt-Drake, of Dulas Court, Pontrilas, Herefordshire, sent me a buff-coloured meadow pipit, which he shot on his land on the 2nd September last. I have met with isabelline varieties of the skylark, corn bunting, house sparrow, and other birds, but this is the first pipit I have seen thus coloured.—W. S. M. D'Urban, Newport House, near Exeter.

HERRING GULLS AND GUILLEMOT.—I was much surprised to see in the October Number of KNOWLEDGE that so experienced an ornithologist as Mr. Cordeaux could give credence to the absurd statement of the cliff climbers of Speeton and Bempton, that the herring gulls carry off the eggs of guillemots "in their feet." Take an ordinary sized guillemot's egg, girthing from six to six and a half inches, and consider how is it possible that the foot of even our largest gull, the greater black-backed (in length about three inches) could clasp and hold securely an egg of the above-mentioned size, or that the small foot of an ivory gull could hold and carry even a little auk? I have lived all my life on the seacoast and been amongst gulls at all seasons, yet I never saw a gull of any species attempt to grasp food of any kind with its feet. Even the large gulls when feeding on a carcase never use their feet to hold the food while tearing it, but merely lay hold with their bills and tear it off the carcase.—ROBERT WARREN, Moy View, Ballina.

[I think Mr. Warren has somewhat misunderstood my note in connection with the herring gulls. I do not anywhere say I give credence to the "absurd statement"—I simply state the facts as I was told them, and sent the note to KNOWLEDGE in the hope of eliciting the opinions of other ornithologists on a matter of which I had no previous cognizance. Regarding what Dr. Hayes says about the ivory gulls carrying off the wounded auks in their feet, Dr. Hayes was far too acute an observer and naturalist to fall into any error regarding facts which must have been patent to the whole of his expedition.—JOHN CORDEAUX.]

[Although neither denying nor altogether accepting the truth of the statement made by the cliff climbers of Speeton, it seems to me quite possible that the herring gulls could carry off the eggs of guillemots in their beaks without breaking them. I have positive proof of a rook carrying an Aylesbury duck's egg in its beak some distance and then dropping it perfectly intact. If a rook could thus carry an egg of about five and a half inches in circumference, could not a herring gull, with a wider gape, carry off an egg of about six inches in circumference?—H.F.W.]

FOOD OF HERONS.—Mr. Armistead's note on the food of herons recalls an interesting experience which I had this spring. Walking one day last April through a well-known heronry, not far from Scarborough, I noticed lying underneath the nests a number of the pellets of indigestible matter which these birds cast up. On macerating them in hot water I found that they consisted principally of the fur and bones of water-voles, together with the hard portions of several species of water-beetles, particularly the *Dytiscus marginalis*. I found only two small remains of fish—a single scale in one pellet, and a few bones and scales in another. Yet these birds were nesting within a couple of miles of a well-stocked lake containing dace and a few trout, which are preserved for the especial benefit of the herons. I am bound to say that I saw the remains of several fish (not in pellets) on the ground in the heronry, but the small proportion of this food compared with the remains of voles and beetles struck me very strongly, and I cannot help thinking that the destructiveness of these birds on trout streams has been magnified, and that the wholesale slaughter by the river watchers is unnecessary. I can understand that on a breeding pond containing small fish they may be very destructive, but that is quite another matter to fishing a stream where the fish have shelter and can take care of themselves. There I am inclined to think the heron does at least as much good as harm.—WM. J. CLARKE, Scarborough.

NIGHT HERON ON THE EXE.—A very fine adult male night heron was, I regret to say, shot in the marshes at Countess Weir in June last. In August I saw a bird flying over our marsh (which is about a mile below Countess Weir), very like a small heron, but with a more rapid and hurried flight. Perhaps, it was the survivor of a pair of night herons which might have bred if they had been undisturbed. This is the first known instance of the occurrence of this beautiful heron on the Exe.—W. S. M. D'URBAN, Newport House, Exeter.

BARRED WARBLER IN NORFOLK.—*Correction.*—In the Rev. Henry H. Slater's note of the occurrence of this bird in Norfolk this year, reported in the last number of KNOWLEDGE (page 240), the wrong date was unfortunately inserted. The date should have been "August 27th," *not* "May 27th."

A PROLIFIC PAIR OF BLACKBIRDS.—Early in March a pair of blackbirds built in ivy on my garden fence, hatched out three young, fed them until they were almost ready to fly, and then a cat killed them all. They then built again lower down on the same fence, nearer the house, and hatched out four young, all of which were killed by the same cat when a week old. In May they built a third nest, high up in a *Pyracanthus*, on the front of my house, and successfully reared four young (one of which, however, got drowned in the flood prevalent when they were weak on the wing). The hen then fresh lined the same nest, and successfully reared five young. The hen blackbird visited her old nest, as though contemplating a fifth family, for about a week after the flight of the fourth brood, but the cock bird did not sing again. I saw him once or twice at the end of my garden in company with his last family, but I do not think any attempt was made towards the production of a fifth brood. I have watched these blackbirds very carefully; they have built in my garden for several years, and I should know the song of the male at once as quite distinct from that of others in the neighbourhood.—A. G. BUTLER, Beckenham.

*Red-footed Falcon in Aberdeenshire* (*Annals of Scottish Natural History*, October, 1897).—Mr. Geo. Sim reports the shooting of a male of this species at Criminmogate on May 7th, 1897.

*The Melodious Warbler* (Hypolais polyglotta) *in Sussex* (*The Ibis* October, 1897, pp. 627 and 628).—Mr. Howard Saunders gives an interesting note of this bird, a specimen of which was shot at Burwash, Sussex, on April 30th, 1897. The occasional visits of *H. polyglotta* to the British Islands have been suspected on good evidence for some time, but this is the first instance of its having been positively identified.

*The Albatross in the North Atlantic* (*The Field*, Vol. XC., September 25th, 1897, p. 500).—Mr. T. Southwell gives particulars of the different occurrences of *Diomedia melanophrys* in the North Atlantic.

*Caspian Tern on the Trent* (*The Naturalist*, October, 1897, p. 308).—Mr. F. B. Whitlock reports the capture, on August 3rd, near Colwick Park, of an adult Caspian tern.

*Montagu's Harrier in Ireland* (*Irish Naturalist*, Vol. VI., No. 10, p. 284).—Mr. John H. Teesdale reports the capture of a young female Montagu's harrier in County Kerry. This bird is one of six (two old and four young) which have been seen about the neighbourhood. From this evidence Mr. Teesdale believes the bird to have bred in the district. Since Montagu's harrier has only been observed two or three times in Ireland, and has never been known to breed there, it would be extremely interesting to have positive evidence on the subject.

*Notes on the Godwits* (Limosa). By E. A. S. Elliot. (*The Ibis*, October, 1897, pp. 564 to 574.)—This is a very interesting article on the habits, plumage, and distribution of the godwits. A great part of the paper deals with the bar-tailed godwit, and it should be read by all interested in these birds.

*All contributions to the column, either in the way of notes or photographs, should be forwarded to* HARRY F. WITHERBY, *at 1, Eliot Place, Blackheath, Kent.*

## Science Notes.

A congress, having for its object the international protection of birds useful to European agriculture, is to be held at Aix-en-Provence during the week commencing on November 9th. All communications with regard to the congress should be addressed to "Le Secrétariat Général, Grand Hôtel Sextius, Aix-en-Provence."

Next year the British Association will meet at Bristol, and in 1899 at Dover.

A modest genius, James Bowman Lindsay, who lacked the art of self-advertisement, first discovered wireless telegraphy and fully appreciated the great possibilities of the invention, but he was unable to secure sufficient public attention to carry his idea into the domain of practical utility. He conceived the idea in 1831, and in 1857 he transmitted messages across the Earl Grey Dock without the aid of wires; while later on he made calculations tending to show that by selecting two stations in Britain, one in Scotland and one in Cornwall, and two corresponding stations in America, it would be possible to send messages across the ocean without the intervention of a cable.

The British Consul at Amoy says, in a letter to the Secretary of the Association of Chambers of Commerce: "My long residence in the East has taught me that the Chinese and Koreans are very superstitious; they will often buy small articles like biscuits, sweets, cosmetics, needles, thread, matches, soap, scent, medicines, etc., for the sake of a lucky label; and they will as often refrain from buying an article because it has to them an unlucky label. The colouring of a label is as important as its design. Some colours and combinations of colours are, to the Chinese and Korean mind, unlucky; other colours, though not unlucky, are considered as only appropriate to certain commodities."

## SOME NEW VIEWS AS TO THE PLANET VENUS.—II.

By Camille Flammarion, F.R.A.S.,

*Author of "Astronomie Populaire," "Les Etoiles," "Les Terres du Ciel," "La Planète Mars," etc.*

AMONGST the remaining observations of any importance I can see only those of Maedler, made in 1833 and 1836. The reports of these observations are also in my possession.* This astronomer, who just then had achieved considerable progress in the study of the planet Mars, begins by saying that he has "never noticed any spot properly so described, save, perhaps, what he observed on the 7th April, 1836," except the diminution in brilliancy from the limb to the terminator, or especially the irregularities of the variations at both horns of the crescent.

"We should not wish," he writes, "like Schroeter, who made a series of observations similar to these, to deduce from them an exact period of rotation, for we are satisfied that this time of rotation cannot be ascertained from observations made upon the shape of the horns of Venus, especially when all other elements of rotation are wanting. But the variations in the outline of the horns which we have noted, at times with a surprising rapidity, if they be not altogether wanting in objective reality, clearly are quite incompatible with the Bianchini period, or any other period of like duration; and, on the other hand, more than one sign seems to be in favour of Cassini's period.

"We willingly admit that there may occur optical deceptions in such determinations of the shape of the cusps and of the elliptic outline of the phase of Venus, which may rest upon no other foundation than the observer's personal opinions; but we consider it impossible to look upon a whole series of observations such as these as mere errors without better reason for so doing. Especially the remarkable variations of the southern cusp cannot by any means have been caused solely by our atmosphere, or by the telescope, for then it must have been seen in the case of the northern horn; however, if they bear any relation to the rotation of Venus, such rotation cannot possibly have a period of several weeks."

It was important to quote these remarks here. And we may add that since they appeared, astronomers no longer consider the rotation of Venus as taking place from south to north, or, as Maedler expresses it, "along the limit of light," but "*perpendicularly to that line.*" This is a somewhat drastic change in the appreciation of the planet's motion, and one, too, which is no more justified by observation than the former. Gradually, however, the southern cusp came to be considered as approximately marking the situation of the south pole, and the northern cusp as representing the north pole.

(6.) In 1839, at the Observatory of the Roman College, Father de Vico, and his colleague, Palomba, threw themselves with great ardour into the task of verifying Bianchini's observations, and believed that they could recognize the circular spots marked on his map.* They made more than ten thousand observations, and satisfied themselves of the motion of those spots. Indeed, De Vico precisely defined the period of rotation as 23h. 21m. 21·9345s. According to the observations of 1839, the angle of inclination was eighty degrees, while according to those of 1840 it was between fifty and sixty degrees. The results of these observations were discussed by M. Schiaparelli with the care and authority which he brings into all his researches,† and he demonstrated that the above value was not founded upon a sufficient agreement between well-established markings on the planet. In fact, De Vico's result may be said to have been derived from his simply begging the question, since in order to account for the changes observed he adopted Schroeter's period of 23h. 21m. 19s. as a basis of computation; for, after all, even those changes are, by the Roman astronomer's own showing, as doubtful as anything can be. Indeed, he himself declares that those spots are uncertain, undefined, smoky, and so like to each other that one can hardly help confusing them. We feel that here again it is a question of luminous effects, or atmospheric appearances. Besides, after the masterly manner in which Dr. Schiaparelli dissected the subject, De Vico's period can no longer lay claim to any solid foundation, and must disappear.

(7.) Whilst thus overthrowing the idea of a brief period of rotation as not founded upon sufficient observation, M. Schiaparelli, in his turn, has proposed that the time of rotation should be assumed to be identical with that of the revolution of the planet, *i.e.*, equal to 224d. 17h. According to this hypothesis the planet would revolve around the sun, constantly turning the same face towards him, as the moon does towards the earth. On the side facing the sun daylight and heat would then prevail indefinitely, while the opposite side would remain per-

* *Fragments sur les Corps Célestes du Système Solaire*, by Beer and Maedler. (Paris, 1840.)

* *Memorie intorno a parecchie osservazioni fatte nella specola in Collegio romano*, 1839, 1840, e 1842.

† *Considerazioni sul moto rotatorio della pianeta Venere*, 1890.

petually dark and cold. Librations, however, would materially vary the bounding line between light and shade.

Whilst Cassini, Bianchini, Schroeter, and De Vico affirm that they had observed certain displacements of spots and certain periodical phenomena, the illustrious Director of the Milan Observatory assures us that the divers markings, whether light or dark, that are sometimes perceptible on the planet Venus, do not move. His main observations extend from the 5th of November, 1877, to the 7th of February, 1878, and comprise about one hundred sketches of the planet, many of which were taken on the same day. At first, viz., between the 5th of November and the 7th of December, the observer "only perceived confused shadows comparable to those of Bianchini and De Vico, and which could by no means serve for a proper estimate of the time of rotation." On the 8th of December the most certain spot was a triangular shade located somewhere near the centre of the visible semi-disc. On the 9th the spot was again seen, and again on the 10th. The apex of this great triangular patch was directed towards the north. Above—*i.e.*, at the southern horn—there might be seen white spots, and these were again visible on the following days. We here reproduce the three illustrations that were published in this connection by M. Schiaparelli. In the first, the region extending from *m* to *h* was the darkest, and this line of direction *m h* will also be found in the two other sketches. This dark trail or streak *h m* was, moreover, seen also by Mr. Holden, at Mount Hamilton, and M. Niesten, at Brussels.

It is chiefly the immobility of this mark for more than a month that convinced M. Schiaparelli of the impossibility of a rapid diurnal rotation. While it was kept under observation for several hours each day, for several days and weeks, it did not alter its position, though it did change in tone and extent.

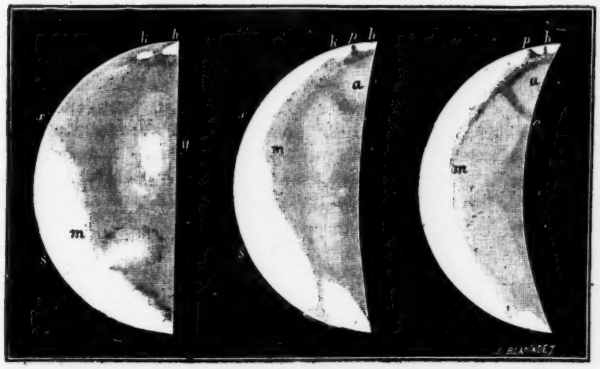


Fig. 6.—Representations of the Planet Venus by M. Schiaparelli, 1877. (*L'Astronomie*, 1890, p. 418.)

In 1895 the same writer reverted to the subject in a letter, quoted below, which he addressed to M. Terby on the 31st of July, in reference to the observations of Herr Leo Brenner—which gentleman, however, so far as he himself is concerned, regards these very same observations as conclusively showing that a rapid rotatory movement is completed in 23h. 57m. 7·5459s.*

"At all events, the present spot of Venus does really and truly exist, and it reflects credit upon Herr Brenner to have called attention to it; for the study of that spot has put the final seal of certainty on the rotation of 224·7 days; whereas, previously, as you well know, the demonstration of that fact had rested upon too small a number of observations.

"I am sending you herewith a copy of one of my drawings taken with the eighteen-inch glass, which I consider the best of all, and which represents the state of the planet during the last few days of July. I have several times compared it with the planet in every detail, and I am satisfied with it on the whole, taking into account that the shades in question are extremely difficult objects. Only the large spot near the southern horn is visible with comparative ease, and my colleague, Dr. Rajna, has satisfied himself of its existence. It is more readily seen during the day, when near culmination, especially when the sky is hazy and the planet comparatively dull. This spot, with the shadows connected with it, is undoubtedly the same that I observed in 1877 (apart from certain minute details). On looking through my old observations, I find that I have sketched the same objects in February and March, 1881. There is evidently a certain stability in the variations, or, at any rate, a periodical recurrence of analogous conditions. The somewhat bold conjectures on the subject to which I gave expression in 1890, are thus verified in as satisfactory a manner as could well be expected.

"However that may be, it will now require a good deal of boldness to return to the 23h. 20m. rotation period again. The spot is there—perfectly motionless at all hours of the day; at least, since the 3rd of July." *

We reproduce this drawing from the original published in the *Bulletin de l'Académie de Belgique*.

Thus, according to M. Schiaparelli, it is this spot that "has put the final seal of certainty" to the rotation of two hundred and twenty-four days, the demonstration of which had rested upon "too small a number of observations." Look also at this phrase: "There is evidently a certain stability in the variations, or, at any rate, a *periodical recurrence* of analogous conditions."

Now there is not the slightest reason for supposing that this spot, any more than the others, forms part of the surface of the planet. If it were a fixed spot on the globe, the careful observations made by Bianchini and De Vico, under the purest sky and by means of excellent objectives, should have demonstrated its presence as well as the more recent investigations to which I am now coming.

At the same time as M. Schiaparelli—in December, 1877—M. Trouvelot made identical observations at Cambridge, but concluded from them a rapid rotation. Indeed, in the markings which the learned chief of the Milan Observatory held to be "stable," he (Trouvelot) notices as many as seventeen changes,† showing clearly that those markings are atmospheric, and not geographical, forms. Once again, if these spots were permanent, as are those of Mars, they would be found in the different series of drawings. Again, any spots on the surface cannot but be invisible, owing to atmospheric absorption, which is not, and cannot be, disputed by any astronomer. Without knowing it, M. Schiaparelli has given us the true word which destroys his own theory. We have there "a *periodical recurrence*" of analogous conditions. How often do we not find, upon the earth, that the same hour brings back the same atmospheric state! Seen from Mars, at an obliquity, and

* *Bulletin de la Société Astronomique de France*, 1895, pp. 275 and 336.

* *Bulletin de l'Académie de Belgique* for August, 1895.

† *Bulletin de la Société Astronomique de France*, 1892, p. 134.

with phases similar to those of Venus, the earth would offer a whitish cloudy appearance, with occasional clear spots, or patches darker than the rest, which might reappear at the same hour of the day; and it would turn under its envelope, which would be frequently opaque, without any of its geographical configurations showing their periodical displacements of twenty-three hours fifty-six minutes. Sometimes, no doubt, our atmosphere is partly transparent, and might allow some details near the centre to be seen. But that of Venus is too dense ever to display so satisfactory a state of transparency.

It is chiefly—nay, solely—upon the elongated grey spot, visible between the terminator and the limb of the planet, that M. Schiaparelli rests his theory. He believes that this spot is real and permanent. We see, in fact, pretty frequently a grey shading of this kind, and this year in particular we have observed it with the equatorial of the Juvisy Observatory. But it is seen equally on the eastern and western crescents—that is to say, in different and opposite regions. This year, for example, I have shown the eastern half of Venus, in my drawing of July 14th (Venus being a morning star), whereon this grey trace is marked, as it also is in M. Antoniadi's drawing of August 30th. In the views taken by M. Schiaparelli, however, the western half is shown (Venus being an evening star). Hence, besides the difficulties already mentioned, it would have to be assumed that the planet was symmetrical on either side of the variable terminator meridian—that it has the shape, say, of a melon, with the poles of the longitudinal ribs or segments precisely coinciding with the cusps of the crescent. That would indeed be a novel theory to establish. It appears that the spot upon which the two hundred and twenty-four days' rotation is founded is more nearly related to the terminator and to the terrestrial observer than to the sun; it is relatively to the earth that it appears fixed, and not relatively to the sun.

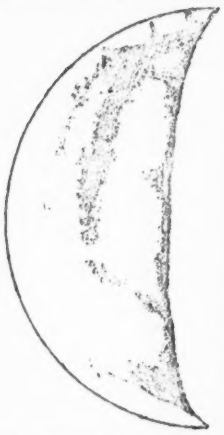

FIG. 7.—A View of Venus taken by M. Schiaparelli, July 31st, 1895.

(8.) I am now coming to the latest observations, for, indeed, this article is already of an extravagant length in spite of my endeavour to be as concise as possible. I will only therefore mention, by the way, the labours of Messrs. Vogel, Terby, Trouvelot, Perrotin, Denning, Niesten, Stuyvaert, Barnard, Stanley Williams, MacEwen, Brenner, and others. We can compare their observations, and the same divergence will be found between their various drawings; nothing is certain, nothing settled, nothing permanent! Light shadows; optical effects produced by contrast with the terminator; atmospheric phenomena due to solar heat, clouds, vapours, etc.

Mr. Lowell writes in his turn as follows, in reference to the observations of 1896:*—"The configurations have always been very sharply defined—as sharply, indeed, as those of the moon; they are, moreover, *lines* rather than spots. Several radiate from certain points. And not only are these lines permanent, but they are also constantly visible; nothing prevents their being seen, except the clouds of our own atmosphere. The period of rotation coincides with the period of revolution. *This planet is a desert.*" And here (Fig. 8) are two of Mr. Lowell's illustrations:—

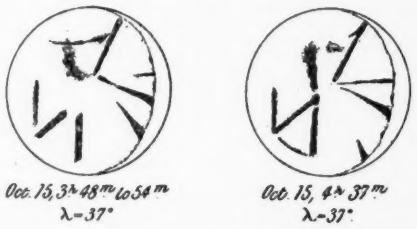


FIG. 8.—The Planet Venus as drawn by Mr. Lowell in 1896.

This description and these drawings, so entirely at variance with all that has gone before, "put the final seal of certainty," as M. Schiaparelli expresses it, to our opinion, viz., that nothing certain can be descried upon the surface of Venus, and that whatever has hitherto been written regarding its period of rotation must be considered null and void.

In all probability the globe of Venus revolves, invisible to us, under its atmosphere, which turns with it, but which affords us no reference points fixed and capable of allowing us to determine this rotation.

There may possibly be a chance of ascertaining it by means of the spectroscope, applied to the opposed east and west limbs, at those epochs when the phase is not too conspicuously marked. Most likely the northern and southern extremities of the disc are not far from the poles, and the edges of the disc are simply atmospheric outlines.

This atmosphere is so dense that its action upon the deformation of the globe is apparent, even during the transits of Venus, in the shape of a black disc across the surface of the sun. M. Bouquet de la Grye, from photographs he took at Puebla, during the transit of December 8th, 1874, ascertained the existence of certain raised portions, which he attributed to the condensation of equatorial vapours and to polar glaciers of great height,* while he estimated for the atmosphere of Venus a height five times as great as that of the earth. These views concerning the situation of the poles tally remarkably well with my own observations and those of my coadjutors at Juvisy † with reference to the polar white spots, as well as with those of M. Trouvelot. Other observers have seen, and drawn, these same white spots, both north and south, but without regarding them as polar. There are besides here indisputable optical effects; but they do not disprove the reality of these spots, as M. Schiaparelli has recognized on his part, though he has denied their polar character.

This year, indeed, we have taken a great many drawings at the Juvisy Observatory, of which nine were reproduced in the plate in the October Number of KNOWLEDGE. The observations were made in full daylight—generally between 8 A.M. and 12 noon. They show very few details. The least doubtful dark spots proved to be the grey marks near the horns; also a vertical diffused streak at three-eighths of the distance between the terminator and limb. The extreme shades are shown in all the sketches, while that near the centre appears in Figs. 2, 4, 5, 6, and 7. In addition a protuberant whiteness was glimpsed on the 11th of June, near the southern horn (Fig. 1). This object,

* *Bulletin de la Société Astronomique de France*, 1897, pp. 139 and 253.

* *Bulletin de la Société Astronomique de France*, 1891, p. 96.

† *Bulletin de la Société Astronomique de France*, 1895, p. 12.

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however, is not altogether certain, and irradiation may here have played a very important part.

In conclusion, we believe that nothing can be affirmed regarding the rotation of Venus, inasmuch as the absorption of its immense atmosphere certainly prevents any detail on its surface from being perceived. The most careful discussion of all the observations leads us to think that the grey spots now and again seen upon Venus are the effects of contrast due to solar illumination, and that the less definite shadings are of an atmospheric nature, incapable of furnishing us with any serious data as to the rotation of the planet. We may state here more than ever that every man sees after his own fashion and draws after his own fashion. We are sure of nothing. The globe of Venus may turn underneath its opaque envelope without any motion manifesting itself to our eyes—unless by some transitory and uncertain effects. No one has ever seen on the surface of Venus any clearly characteristic spot analogous to those shown on the discs of Mars and the moon. The maps of Venus made up to the present time are illusions.

## BOOKS RECEIVED.

*Natural Causes and Supernatural Seemings.* By Henry Maudsley, M.D. Third Edition. (Kegan Paul.) 12s.

*The Centuries: a Chronological Synopsis of History on the "Space-for-Time" Method.* Second Edition. (West, Newman, & Co.)

*The Story of Germ Life.* By H. W. Conn. (Newnes.) Illustrated. 1s.

*Lumen.* By Camille Flammarion. (Heinemann.) 3s. 6d.

*The Machinery of the Universe.* By A. E. Dolbear. (Society for Promoting Christian Knowledge.) Illustrated. 2s.

*Memory and its Cultivation.* By F. W. Edridge-Green. (Kegan Paul.) Illustrated. 5s.

*A Question of the Land and Water.* By Dante Alighieri. (David Nutt.) 2s.

*The Mathematical Psychology of Gratz and Boole.* By Mary Everest Boole. (Sonnenschein.) 3s.

*The Building of the Intellect.* By Douglas M. Gane. (Elliot Stock). 5s.

*Recent and Coming Eclipses.* By Sir Norman Lockyer. (Macmillan.) Illustrated. 6s. net.

*Electricity in the Service of Man.* By Dr. Wormell. Revised and Enlarged by Prof. Walmsley. (Cassell & Co.) Illustrated. 7s. 6d.

*The Works of Archimedes.* By Dr. T. L. Heath. (Cambridge University Press.) Illustrated. 15s.

*Thermo-Geographical Studies.* By C. L. Madsen. (Copenhagen: Gad.)

*The Dynamics of Religion.* By M. W. Wiseman. (The University Press, Limited.)

*Ornamental Design for Woven Fabrics.* By C. Stephenson and F. Suddards. (Methuen.) Illustrated. 7s. 6d.

*The Elements of Astronomy.* By Prof. Young. (Green & Co.) Illustrated.

*Applied Mechanics.* By Prof. Perry. (Cassell & Co.) Illustrated. 9s.

*Organic Chemical Manipulation.* By J. T. Hewitt. (Whittaker & Co.) Illustrated. 7s. 6d. net.

*John Hunter.* By Stephen Paget. (Unwin.) Portrait. 3s. 6d.

*A History of China from the Earliest Days down to the Present.* By J. Macgowan. (Kegan Paul.) 16s. net.

*Humanitarian Essays.* Various Authors. Edited by Henry S. Salt. (Reeves.) 1s.

*Practical Physiology.* By Albert F. Blaisdell. (Ginn & Co.) Illustrated. 5s.

*Montaigne and Shakespeare.* By John M. Robertson. (The University Press, Limited.) 5s.

*Progress in Printing and the Graphic Arts during the Victorian Era.* By John Southward. (Simpkin, Marshall, & Co.) 2s. 6d.

Sir George Newnes, Limited, by special arrangement with Messrs. Constable, are about to issue a popular edition of Dr. Nansen's "Farthest North." The book will be issued in twenty sixpenny fortnightly parts.

## PHOTOGRAPH OF THE MOON.

*Age, 9d. 10h. 7m.*

*(See Collotype Plate.)*

THE accompanying photograph has an interest beyond that attaching to it as a representation of the moon, in that it was taken with a refractor ordinarily corrected for the visual rays, but which, according to the plan suggested by Sir G. G. Stokes, has been adapted for photography by reversing the crown lens, and moving it somewhat further away from the flint lens. The delicacy of the detail shown in the negative is a sufficient proof how thoroughly successful the arrangement has been; and as the importance of photography is constantly on the increase in astronomy, it points out an easy way of rendering an instrument suitable at once for direct visual use, and for employment with the sensitive use. There are several other methods of securing the same result—the new triple achromatic object glasses, designed by Mr. Dennis Taylor; the addition of a correcting lens to an ordinary achromatic, as in the case of the thirty-six-inch refractor of the Lick Observatory; and in the employment of ortho-chromatic plates. It should, however, be remembered that no objective has yet been constructed on Mr. Dennis Taylor's principle nearly so large as the twenty-eight-inch refractor of the Royal Observatory, Greenwich, the telescope with which the original of our plate was taken; and that the aperture of the Lick object glass is usually cut down to one-fourth of its full diameter when used for lunar photography, whereas the full twenty-eight inches were employed in the Greenwich instrument.

The plate used was a Hill-Norris dry collodion plate, eagle brand, with an exposure of half a second; and it was taken on March 12th, 1897, at 10h. 3m. G.M.T., by Mr. T. Lewis, F.R.A.S. The plate was exposed in the primary focus, the original having been enlarged three diameters in the present reproduction, permission to make which was kindly granted by the Astronomer Royal.

## Letters.

[The Editors do not hold themselves responsible for the opinions or statements of correspondents.]

### "MORE ABOUT ANTIVENENE."

*To the Editors of* KNOWLEDGE.

SIRS,—In continuation of the correspondence which has arisen between Dr. McPherson and myself on the subject of snake poison, I would point out that the wording of the original statement in the article "More about Antivenene," which appeared in the September Number of KNOWLEDGE, is as follows:—"Venom is almost inert when introduced into the stomach. . . . After repeated experiments on white rats, he (Prof. Fraser) found that when the snake's poison is introduced into the stomach it does not produce any active poisoning effects, but some of it seems to be absorbed into the animal's blood so as to assist in the immunization. Why was this? In Prof. Fraser's opinion, when venom is introduced into the stomach, the chemical changes wrought by the acids of the stomach destroy its fatality to a large extent."

The natural interpretation of this statement appears to me to be that snake poison is harmless when introduced into the stomach, and that this harmlessness is, to a large extent, attributable to the action of the acids in the stomach; not, as Dr. McPherson explains in his reply to my letter in the October Number of your paper, that snake poison can be introduced into the stomach *up to a certain extent* without producing any active poisonous effects. I

thought—and I was, I submit, justified in thinking—that your readers would understand the statement as I did.

In his reply, Dr. McPherson goes on to say that if a minute dose (one-fifth of a lethal dose) is introduced into the stomach, and is gradually increased, the patient becomes fortified against an excessive dose.

Admitted; but very much the same thing happens when poison is injected. I will refer to Dr. McPherson's own words in his article on "Antivenene" which appeared in Knowledge, August, 1895, viz., that "Prof. Fraser injected a horse with one-fifth of a lethal quantity, and gradually increased to perhaps fifteen times a lethal dose," without killing the horse.

Now, I see that so high an authority as Sir J. Fayrer states that "snake poison is *deadly* when applied to a mucous or serous membrane, *to the stomach*, or conjunctiva."* Again, I find, in Drs. Mitchell's and Reichert's "Researches upon the Venoms of Poisonous Serpents":†—"Certainly cobra venom is much more apt to kill when swallowed than is crotalus poison. In the rattlesnakes it is the globulins which are in largest amount, and which are not dialyzable; but in the cobra the fatal peptone is the material which, both as to vigour and amount, represents the poisoning capacity, and is, as we know, dialyzable. It is only astonishing, therefore, that it does not kill in every case in which it is swallowed; but, as we have seen, the gastric juices, in so far as they have time to act, are destructive of venoms, and hence their protective agency has to be considered." (It is fair to say that the American experiments were not conducted with fresh cobra venom, as was the case with Sir J. Fayrer.)

The real question is whether an ordinary dose of snake poison, which would kill if injected, will or will not produce dangerous and even fatal results when introduced into the stomach, *i.e.*, swallowed. I am sure we shall be very grateful to Dr. McPherson if he is able, from his acquaintance with recent experiments, to give us a definite answer to this question through the medium of your columns.

With regard to the by-question of the relative virulence of rattlesnake poison, I did not wish to suggest that the rattlesnake was not a highly venomous serpent, but I did question its claim to being described as one of the most deadly. This view appears to me to be supported by the quotation already made from the "Smithsonian Contributions to Knowledge." In Vol. XII., pp. 100, 101, of the same series, sixteen cases of people bitten by rattlesnakes are recorded, and of these four only terminated fatally. In one of these four cases the man was drunk when bitten, and did not apply for aid for two or three hours. I venture to say that if he had been bitten by a cobra, or even a tiger-snake (*Notechis scutatus*), he would have been past asking for help in half the time or less. In another fatal case only such primitive remedies were used as olive oil, leeches, and cauterization; a ligature was indeed applied, but afterwards removed. On the other hand, two of the sufferers who recovered were bitten in the throat. The rattlesnake is black enough, but not so black as he is painted.

Lionel Jervis.

16th October, 1897.

## BIRD-SONGS IN AUTUMN.

*To the Editors of* Knowledge.

Sirs,—Referring to my article in Knowledge (October), I am surprised and very sorry to find that Mr. O. V. Aplin thinks I misrepresented him as stating that the robin and starling commence singing in October or November. I can only say I have had considerable difficulty in discovering the error, which was wholly unintended. Mr. Aplin is so well known an ornithologist that I should like to explain my position by quoting Mr. Aplin's article more fully, as follows (*Zoologist*, 1894, p. 410):—

"Some species become silent shortly *before* they moult in early autumn. They cease singing when they have done breeding, or as soon as their young have hatched. Others sing much later in the summer. After the song has ceased and an interval has elapsed, in certain cases we hear it again. From mid-August on into November the second song may be heard. This is the autumn song. Some birds, if the weather be genial, strike up in November (or even in October), and may be heard all through the winter in mild weather; but this is not an autumn song, properly so-called. It is the beginning of their ordinary song, which they will continue through the following spring. Such birds are the song thrush, robin, wren, hedge sparrow, and starling. . . . The song thrush I have heard singing feebly at the latter end of September and in October. The regular song is commenced sometimes as early as November. . . . The robin's autumn song is of course familiar to everybody. The broken strains we hear at first are most probably the productions of young birds just over their moult. . . . We should not expect [young nightingales] to make attempts at singing in autumn, like the precocious young robins. . . . The great titmouse has the autumn song, and is heard sometimes in September and October. The wren sings loudly in October, but this is probably merely an early opening of the regular spring song, which goes on in fine weather all the winter. . . . The starling sings in October, but here again there is a difficulty in determining to which category its chattering notes and whistling should be assigned."

I now find that Mr. Aplin distinguishes the late autumn song (the beginning of the spring song) from the true autumn song; but I do not see how this can be done in regard to the robin, or the starling, or the thrush, wren, hedge sparrow, great titmouse, or skylark, all of which sing from the time of "striking up" in July, August, or later, till the spring, unless silenced by cold.

With regard to my suggestion that the willow wrens of different districts may sing at different periods, Mr. C. B. Moffat writes from Ballyhyland, Enniscorthy, Co. Wexford, that the spring song of these birds in his neighbourhood is sometimes continued till the 12th of July, the last dates in some recent years having been the 6th, 9th, and 11th of that month. The autumn song is there only heard during the first two weeks of August, and never in September. Similarly, at Eltham, in Kent, where willow wrens swarm, I did not once hear their song in September. So few, indeed, are the autumn singers in this species that one cannot help surmising that they are birds which did not breed in spring.

Charles A. Witchell.

## BIELA'S COMET.

*To the Editors of* Knowledge.

Sirs,—I should be glad to learn if anything is known of the movements of Biela's comet (if still in existence) since 1872, when Pogson thought it touched the earth. According to the period assigned to it, I suppose it should come within telescopic view some time in 1899. Is this so, please?

Regd. Bainbridge.

[It is exceedingly doubtful whether the comet glimpsed by Pogson on December 2nd and 3rd, 1872, can have

* "Thanatophidia of India," p. 64.
† "Smithsonian Contributions to Knowledge," Vol. XXVI., p. 45.

been Biela's comet. The last certain observation of it took place in the autumn of 1852. The comet would now appear to be represented by a meteor stream which we encounter towards the end of November. A fine display was noted in November, 1872, and again thirteen years later in November, 1885. We may therefore look forward confidently to a striking display in 1898. It should be noted that though the mass of the meteors giving rise to the shower move in the same orbit as the comet, they are not coincident with it, but in the case of the shower of November, 1872, were following the computed place of the comet at a distance of about twelve weeks.

It may be interesting to recall that the comet discovered by Mr. Perring in the end of last year (Comet G, 1896), on 1896, December 8, had an orbit very closely resembling that of Biela in every respect except the position of its major axis.—E. Walter Maunder.]

### THE MÈTRE AND THE INCH.

*To the Editors of* Knowledge.

Sirs,—I am not aware that the following argument for keeping the mètre and the inch in concurrent use has been published hitherto.

Suppose an artificer has to make a vase true to a scale pattern drawing. He wishes to test his work. If on measuring his drawing across at any height from the base with a straightedge divided into eighths of an inch he finds, say, 16 eighths, and again measuring the circumference of his work at the corresponding height with a centimètre tape he finds it 16 centimètres, then he may know that his work is correct.

This depends on the following approximate propositions:—

250,000,000 inches = the semi-axis of rotation of the earth nearly.

10,000,000 mètres = the quadrant of Paris more nearly.

Hence—

2 mètres : 25 inches
1 mètre : 12·5 inches } = $\pi$ : 1
1 centimètre : $\frac{1}{8}$ inch

True to about 1 in 400.

T. Wilson.

Harpenden.

## Science Notes.

While gold is justly considered as one of the rarest metals, it is also one of the most widely diffused, as is shown in the September Number of *Popular Science*, in a description of an assay of clay within the limits of the city of Philadelphia. A block of clay a cubic foot in volume, as it lies in the ground, weighs one hundred and twenty pounds, and the assay gives seven-tenths of a grain of gold to the cubic foot, the gold being very uniformly distributed. Under the streets and houses lie four thousand one hundred and eighty million cubic feet of clay, in which securely lies one hundred and twenty-six million dollars. And if, as is pretty certain, the corporate limits of the city would afford eight times this bulk of clay, we have more gold than has yet been brought, according to statistics, from California and Australia.

A meteoric stone, weighing eighty tons, the largest in the world, was found some years ago in Greenland by Lieutenant Peary. It was transported this autumn to Sydney, Cape Breton Island, on board the steamer *Hope*, and is to be landed at New York.

## ENGLISH PLAINS AND ESCARPMENTS.

By R. Lydekker, B.A.Cantab., F.R.S.

Having lately been conducting a small party of military students on a short geological tour in the West of England, in the course of it I have been much struck with the remarkable similarity of the scenery of different districts, due to similarity in the mineralogical identity of geological formations of widely different ages. This is, of course, a fact well known to geologists, and one with which I have long been personally familiar, both in this country and in India. Nevertheless, the phenomenon impressed itself very deeply in my mind on this occasion; and as it is one with which many of the readers of Knowledge may be unacquainted, a brief account will probably be found interesting, in spite of the fact that I have nothing new to communicate.

If a resident in the neighbourhood of Chatham or Rochester take a walk to the summit of the North Downs at Bluebell Hill, he will come upon what is technically known as the escarpment of the Chalk—that is to say, upon a line of irregular and somewhat abrupt cliffs in which the strata are sloping, or dipping, from the face of the escarpment towards the centre of the hill. Below him lie some irregular steps or hillocks of lower Chalk and marl in advance of the main escarpment, and then he sees, stretching out for a distance of about a mile in transverse extent, a flat plain formed by the blue clay of the Gault, through which the river lazily wanders, and whose surface is thickly dotted with oak trees. This Gault formation immediately underlies the Chalk and its associated sands and marls, and is known to geologists as the Gault plain; its northern limits being frequently defined by a line of springs arising from the supersaturated Chalk.

Let him next descend the Chalk escarpment and walk across the Gault plain in the direction of Maidstone, when he will come upon another range of hills considerably lower than the Chalk, and consisting partly of pure white and yellow sands and partly of impure limestones (Kentish Rag). These hills are constituted by the Lower Greensand formation, which underlies the Gault, and continues as far as the village of Yalding, situated on the Medway some distance above Maidstone. Here he comes upon another line of escarpment running in an easterly and westerly direction; and below him lies another plain identical in appearance with the Gault plain he has left behind, only of considerably wider extent. There is the same black heavy soil, forming an unbroken flat intersected by the same stream, bearing a similar crop of oak forest, and defined by a similar line of springs on its northern boundary. Looking on this tract, anyone not a practical geologist would almost certainly say he was on the same stratum as the Gault plain. Nevertheless, the two plains are separated by the whole thickness of the Lower Greensand; and whereas the Gault clay is of marine origin, the Weald clay, which is the formation exposed at Yalding, was deposited in fresh-water, as is proved by the nature of its organic remains.

If the traveller next passes to the districts lying to the north-west of the Chiltern Hills, or into Dorsetshire, and thus reaches the country of the Oolites, he will find several flat tracts of clay which might also quite easily be mistaken for the Gault plain. For instance, in the neighbourhood of Swindon the Portland Oolite, which is one of the highest beds of the Jurassic or Oolitic series, escarps on to the plain of the Kimeridge Clay; while the Coral Rag, which underlies the latter, forms a second escarpment on to the still older Oxford Clay, as is well seen in the neighbour-

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hood of Weymouth, especially near Sandsfoot Castle. Both these clay plains are exceedingly like the Gault plain, except that the number of oaks is usually less. It is the plain of the Oxford Clay that forms the greater part of the Cambridgeshire fens; the reason why this area has become fen being that the rivers have cut down to within a very slight elevation of the sea-level—or, as it is called, to their base of erosion—and the natural drainage of the country is consequently very imperfect. In such tracts water stagnates, peat is formed, and the soil is unsuitable for the growth of any trees but willows.

Crossing the Cotswolds, similar escarpments of massive limestones on to flat plains of clay are again met with in rocks of still older geological age. In the neighbourhood of Bath the chief escarpment is formed by the massive limestone of the Great Oolite on to the clay of the underlying Fuller's Earth. But in the neighbourhood of Cheltenham it is the limestone of the Inferior Oolite, situated beneath the Fuller's Earth, which makes the great escarpment on to the wide, open plain of the Lower Lias clay of the Vale of Gloucester. This Lias plain is one of the largest of all such tracts, and supports in many places a thick growth of oaks. Viewed from the heights of Leckhampton Hill, or Cleave Hill, in the neighbourhood of Cheltenham, it is difficult to realize that we are not looking down upon the plain of either the Gault or the Weald clay of the South-East of England, although we are really on a geological horizon many thousands of feet below that of either of the two latter.

This Lias plain of the Vale of Gloucester is extended to the foot of the Malvern Hills by the red and green marls and sandstones of the Trias series, which, although really situated beneath the Lias, have such a gentle inclination as apparently to form but a single plain with the latter. At Malvern the Trias plain is brought to an abrupt end by the great fault which brings up the igneous and metamorphic rocks of the Malvern Hills. And, looking down from the summit of this range towards Gloucester, the great plain below is almost exactly similar to that of the Lias, with the exception that it carries fewer oaks. But even this last by no means exhausts the list of the great clay formations which constitute plains in different parts of the country. If we proceed westwards from Gloucester, and cross the Severn in the direction of the Forest of Dean, we first traverse one or more high ridges, composed of the red sandstones and clays of the Devonian system, followed by the Carboniferous Limestone and the Milestone Grit, and then suddenly find ourselves on the open plain of the Forest of Dean, formed by the clays and shales of the Coal Measures, interstratified among which are the seams of workable coal. The forest is a level tract of somewhat swampy ground thickly carpeted with a coat of mossy turf, and roofed above with a dense growth of oaks, to the exclusion of almost every other kind of tree. And so like are the two areas that the non-geological observer might well believe himself to be in the uncultivated portions of the Weald of Kent, the soil of which Sedgwick years ago named the "oak-tree clay." But, whereas the clay of the one period was laid down far back in the Palæozoic epoch, when the forests consisted mainly of gigantic club-mosses, huge mare's-tail-like plants, tree-ferns, and araucarias, that of the latter was deposited late in the Secondary epoch, at a time when the vegetation approached that of the tropical zone of to-day. Structurally the clay plain of the Forest of Dean differs from all those mentioned above in that the high ground forming its boundary is not an escarpment, the Coal Measures being newer than the Devonian rocks forming the high ground; whereas, in the case of an escarpment, the clay plain at its foot is the older of the two. Nevertheless, the general effect is very much the same in the two cases.

We thus find that, exclusive of the Tertiary formations, no less than seven great clay plains occur on different geological horizons in various parts of England. These, in descending order, include the plain of the Gault, of the Weald Clay, of the Kimeridge Clay, of the Oxford Clay, of the Fuller's Earth, of the Lias and Trias, and of the Coal Measures. And so like are these to one another, that even the experienced geologist may frequently at first sight mistake the one for the other, if the form of the escarpment of harder rocks be concealed from view.

That such plains should be very similar in physical appearance and in the vegetation they support is only natural, seeing that clay of one geological epoch is very like that of another. The curious fact of the matter is how these plains came to be exposed on so many different geological horizons, seeing that in all cases they were originally covered by the harder limestone rocks which now form their bordering escarpments. Of course the laying bare of the clays is the work of denudation, and that chiefly effected by subaërial agencies—that is, by rivers, rain, wind, "weathering," etc. But looking down from the heights of the Cotswolds on to the Vale of Gloucester, or from the North or South Downs on to the Weald of Kent, it seems difficult to realize that the hard limestone of the former range, or the solid chalk of the latter, is capable of being worn away faster than the soft clay at its base. The important factor in the matter is, however, undoubtedly the circumstance that while limestone, or sandstone (which constitutes some escarpments), is permeable by water, clay is not. Consequently the limestones (or sandstones) are worn away with comparative rapidity, while the clays beneath remain to form the plain at the base. And as Chalk is softer and more easily worn away than the hard Oolitic limestone of the Cotswolds, it is easy to see why the Chalk escarpments of the North and South Downs are now far removed from the centre of the Weald, over which the Chalk once extended, while the escarpment of the Oolites at Cheltenham is less distant from the westerly limits of the underlying Lias.

Still this does not explain the origin of escarpments as such; and I confess that I have hitherto seen no explanation of the origin of these features which is altogether satisfactory, neither have I been able to evolve one for myself. That escarpments as they now exist were not formed by the sea is evident; although marine action doubtless aided in planing down the land as it was being first raised above the ocean level. By some means or other the lines of escarpment were, however, definitely marked out after the upheaval of the land; and when once defined, it is perfectly easy to understand how they are maintained.

The number of escarpments bordered at the foot by a plain of clay is a peculiarity of the geology of England (and to a certain extent of the adjacent parts of the Continent as well), due in the first place to alternate risings and sinkings in the old ocean floor, and in the second place to the consequent alternation of impervious beds of shallow water clays with layers of limestones deposited in deeper water. Limestones of different ages nearly always differ from one another in hardness or compactness, and consequently weather into escarpments distinguished by some peculiarity of contour; but clays present no such distinctive differences, with the result that the various plains formed by those of widely different ages are almost indistinguishable in physical features from one another.

## THE LANGUAGE OF SHAKESPEARE'S GREENWOOD.—III.

By GEORGE MORLEY.

THAT the object which I had in view when jotting down some of the peculiarities of speech of the Warwickshire rustic, as explained in my first sketch in the June Number of KNOWLEDGE (to wit to write a chatty account of some of the dialect words of Shakespeare's greenwood, rather than a dry, analytical, and learned treatise on provincialisms), has been accomplished, seems to be proved by the very interesting correspondence which the subject has elicited from dwellers in Yorkshire, Lancashire, Shropshire, and Kent.

Nearer "the heart of England," as Drayton has well called Warwickshire, than the above-named counties, it need occasion no surprise to find the similitude of the common tongue very marked in certain words, because the commingling of inhabitants dwelling upon the fringes of the shires would naturally effect this. Indeed, as pointed out in my first paper, some of the dialect words cited are to be met with in the adjoining counties, notably in Staffordshire, where, among working class folk, the sympathetic word "nesh" is in frequent use.

That the language characteristic of the soil of rural Warwickshire has similitudes so much farther north of those counties—even, as a Lancashire correspondent informs me, in the scene of Mr. Crockett's "Raiders" in the "land of brown heath and shaggy wood"—is a very delightful fact, which serves to show the influence which the idiomatic speech of Shakespeare's days has had upon the people of these islands; for, as has been very clearly shown, many of the words selected in my two first papers as examples of the dialect current to-day in the sequestered Warwickshire woodland, and which are also, as correspondents assert, in active use in their counties, are taken direct from the works of Shakespeare, and may reasonably be concluded to be words in the mother tongue of the poet himself, uttered in his childhood more than three centuries ago.

To those correspondents, therefore, from the above four counties, who have so kindly pointed out to me the resemblance between certain words in the language of Shakespeare's greenwood and words in the dialect of places from which they write, my thanks are cordially due and are very gratefully given; since it is only by such communications that facts of considerable interest can be made plain, and our knowledge of an important subject be materially increased.

Further interest may probably attach to this attractive subject if my two previous articles are now briefly amplified by a selection of dialect words which I regard as especially Warwickshire words; words which are peculiar to the language of Shakespeare's greenwood, though variants of them may be heard in other neighbourhoods near Warwickshire; and words, moreover, which by their singularity and quaintness cannot but be regarded as picturesque and valuable examples of a dialect more rich in strength, in simplicity, in poetical force, and in the qualities of endurance than many other English dialects.

As an apt illustration of the poetry of the so-called "common tongue" of the Warwickshire rustic, the term "deaf nut," mentioned in my first paper, may be here cited. The real meaning of the term is a hollow nut, a nut without a kernel; but the latent poetical instinct implanted in the breast of the Arden peasant gives it a higher significance, and applies it to affections of the heart.

When a Warwickshire maiden's young man has left her to seek his fortune at "gay Brookington" or elsewhere, she will say with a demure face, "Hey, my life's that holler now, 'tis like a deaf nut from Cuddington 'Ood," dropping the "w" in the manner usual with the peasants of this greenwood when uttering the words "wood" or "would." A mother's heart is "like a deaf nut," void and withered, when her child's love has gone from it.

Singularly expressive, too, is the word "tooting," so often heard tripping from the tongue of the rustic housewife. "Donna thee come tootin' about arter my lad, Jacobina," a mother will say; "othergates I shall tell thy fayther, an' then ye'll get it mortal illconvenient, I mek no doubt." In the meaning of the Warwickshire peasant to "toot about" is to hang, to slink, to sidle, and to idle about; sometimes with a precise object in view (as when Jacobina desires to wheedle Jack into taking her to the Warwick statute fair—"the Mop," as she would call it), at other times without it. The range of subjects and objects to which "toot" and "tooting" may be applied is very wide indeed; from the bailiff tooting about the farm buildings before taking possession, to the ancient grimalkin who toots about the dairy in the hope of surreptitiously enjoying a dish of new cream.

The word "brevet," though lacking the individuality of "toot," is often used in exchange with that word, and has a somewhat similar signification. "Now donna thee brevet about that rick-straddle, or thee'lt hev it on top on thee," is a sentence that may often be heard in the Warwickshire harvest field. Literally, the meaning of the word "brevet" is to sniff about, like a dog; but common usage has applied the word to any person or creature of an inquisitive turn of mind, and even the parsons of certain villages have not infrequently been accused of "brevettin'" their noses about into the business of other folks.

An illustration of the simplicity of the dialect of rural Warwickshire is happily shown in the expressive, almost pictorial, word, "othergates." In the language of Shakespeare's greenwood "othergates" is a substitution for "otherwise"—in another manner. If you cannot do a thing this way you must do it that. If this gate is closed, that may be open. "Ye mun do what I tell thee, othergates—" meaning that, if you do not, some other way must be found to make you do it. The strength and simplicity of this word is not a little remarkable, and, as it is spoken by the rustic, sometimes with a shake of the head to foreshadow the cost of a broken rule, it has that engaging and picturesque effect so peculiar to the Warwickshire dialect.

Certainly one of the quaintest words in the language of this classic greenwood is the word "colly." The townsman would surely say that the word stood for a very well-known member of the canine race, which the Warwickshire shepherd invariably has sidling at his heels. If the townsman were wandering down one of these hidden leafy lanes some morning, with a dark and gloomy sky overhead, and were to get into conversation with a chance native, it would not be long ere he would be entirely disillusioned, for the rustic when speaking of the weather (a subject upon which the peasant is always the spokesman and prophet of his own country) would be almost sure to say: "'Tis a mortal colly mornin', inna it, sir?"

It will thus be seen that when the Warwickshire peasant speaks of a "colly" morning, he means a dark, gloomy

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morning. Anything black, dull, or oppressive, is to him a "colly" thing. A dark night is a "colly" night; a black horse, cow, or dog is "a colly 'un," as the case may be; and whenever the prospect of a rustic's life is at all a shadowed one, it is for him a very "colly outlook." This word is as quaint as it is singular, and reveals the dwellers in this delightful greenwood in quite a picturesque and characteristic vein.

To my thinking there are few prettier or more attractive words in the vocabulary of the Warwickshire rustic than the word "rimming." This is probably a word grown exclusively in Shakespeare's greenwood, and is racy of the soil, seeing that the lot of the peasant here, being (as he is) chiefly a hired servant, condemns him to a continual course of change. "I'm rimmin' to Long Compton this Marti'mas," or "I shall hev to rim over to Hillboro' just now, I reckon, as my time's up here," are familiar sentences to those who are brought into contact with the Warwickshire field worker. To "rim" is the rustic's poetical way of saying to "move"—to go from one place to another. With him and his women folk it is "rimming," not "moving," and it must be frankly admitted that "rimming" is by far the more euphonious word of the two.

Quite in accordance with the literary reputation of "leafy Warwickshire," the rustic of that greenwood has the word "scribe" in prominent use in his everyday tongue. The sound of the name, however, is all that is literary about it. "Ah," cries an anxious and fond mother with a tiresome baby in her arms, "he's a poor dwindling scribe"; and that outburst of lap-sorrow exactly explains the word. A "scribe" is a weak, puling, and ailing child.

This sympathetic word is perhaps more exclusively a Warwickshire word than either "nesh," or "recklin'," or dillin'," which were dealt with in my former jottings, and which correspondents have informed me are in use in their counties. Indeed, "scribe," with the rustic signification attached to it, is a very fine and expressive word, and full of humour to boot, as well as pathos.

As a specimen of the enduring qualities of the Warwickshire rustic dialect, instance may be made of the popularly current word "mortal." At the "Mothering" or "Thomasing" this word is richly in evidence, and is full of warmth, forethought, and homeliness. "Hey, I'm mortal glad to see thee," will say the good mother to her daughter, newly arrived from some distant outlying farmstead; and the daughter will invariably reply, "So are I glad to see thee, mother, though I were mortal afraid o' comin' 'cause o' the floods."

The "mortal glad" of the rural dweller is the "extremely glad" of the resident in town. "Mortal," as the rustic means it, is the extreme in everything. Now this word "mortal," with precisely the same rendering as now attaches to it, was used by Shakespeare in "As You Like It" (Act II., Scene 4), where Touchstone says: "We that are true lovers run into strange capers; but as all is mortal in nature, so is all nature in love mortal in folly"—signifying extreme in folly.

With this fine and impressive example of the enduring power of the language of Shakespeare's greenwood my brief amplification must be brought to a close. It was my desire in this set of sketches in Knowledge to write a few bright, apposite jottings upon a subject which, though deeply interesting, has had far too little attention paid to it; and my hope is that the wish has been realized. My claims for the dialect of the Warwickshire rustic are, that it is a strong, expressive, poetical, picturesque, simple, and enduring language, and more nearly allied to the language of the English Bible and the works of Shakespeare than any other English dialect.

## EGG COLLECTING IN ITS RELATION TO SCIENCE.

By Leopold Field, F.R.S.E.

"Oology is the poetry of ornithology."—*Seebohm.*

If it be true that in all labour there is profit, then every description of collecting should be remunerative. For any collection, however trivial, and by whatsoever process accumulated (except, of course, that of out-and-out purchase), must have cost its constructor a certain amount of mental and physical exertion. Viewed in this light, even the collector of stamps or crests acquires a certain status, as cave crabs remain crabs although their organs are rudimentary. Philatelism, certainly, has its ardent votaries and apologists; but beyond acting as a picturesque lackey to political geography, it would be difficult to indicate the precise manner in which that phase of the *rabies colligendi* has advanced individual or general knowledge. Considerably more can be said in favour of coins, pottery, weapons, and all such objects as throw light upon, or impart a more tangible interest to, our knowledge of man. In these subjects, obviously, authenticity is the desideratum: the difficulty of establishing it the stumbling-block. In the domain of natural history alone can the collector rely upon the genuine character of his evidence, and make sound deductions therefrom, providing always he be able and willing to appreciate it. It is not presumptuous to assert that our knowledge of natural history is as largely derived from the formation and study of collections as that of the physical sciences is from experiment.

Oology, which has but recently and grudgingly been recognized as a science, owes its very existence to the love of collecting. For the oologist no tree is too lofty, no desert too hot, no climate too inclement, where there are eggs to be obtained. The same instinct which leads the schoolboy to brave the terrors of ferule and gamekeeper, crag and pine tree, inspires him as man to spend months in frozen tundras or on burning plains. Truly, oology must ever remain a subordinate branch of bird-lore. But it is an indispensable one, and its indications have occasionally enabled naturalists to form and confirm opinions for which the evidence of the bird itself gave inadequate warrant. As Seebohm says: "It would be as absurd to base a classification of birds on their eggs alone as it would be to do so on any other single character. . . . . No classification based on one character alone can be of any value." Now I hope to show, chiefly by the aid of others' experience, in what manner oology may act as exponent to her elder sister, ornithology. To begin, I will say a word or two on the essentials of a good collection of eggs—good, that is, in terms of scientific utility, without regard to neatness of blowing or elegance of mounting.

Prof. Newton, in his terse but pregnant pamphlet on this subject, gives the two great essentials of an egg collection as identification and authenticity. Rendered colloquially this signifies that a collector should first make himself sure about his egg, and then mark it so that others may always share his certainty. With the latter point, as being more a question of technique, I do not propose to deal; but it is impossible to insist too strongly upon the full and absolute identification of an egg, for eggs occupy an almost unique position among other objects of collection, in that they are subsidiary—bye-products, so to speak. On reflection, I can find nothing analogous in nature, except the seeds of plants—unless, indeed, one were to be curious in the spawn of fishes. A flower, a shell, a bird, leaves no room for doubt in the mind of a competent possessor. The specimen is known to him, or it can be

identified by reference, or it is entirely a new species. In any case the object carries its own credentials: no collateral evidence is necessary. With an egg, however, the case is different. Suppose a collector finds a nest on the ground, say, with four or five bluish white eggs. They can only be harriers'. True; but which of the three? Size is the only criterion, and then they may be large Montagu's or small hen harriers'. In no case would a conscientious collector feel justified in admitting the clutch to his collection without a very conspicuous query on the label. Had he secured the bird, no doubt would have remained to mar his triumph. But it is not always in the power, nor, let us hope, in the heart, of a collector to procure evidence by these drastic means. He can, nevertheless, generally obtain the testimony afforded by a clear and repeated view of the bird, the position and structure of the nest, and the locality. All these data he should most carefully note. United to the character of the eggs themselves, they will furnish tolerably conclusive evidence. It must be noted, however, that the identification of an egg from seeing the bird rise apparently from off the nest is not invariably certain. Prof. Newton cites the instance of a purple sandpiper and a dunlin which had nested within a few yards of each other. The sandpiper rose, and the collector found the dunlin's eggs, whereat he was much amazed; but he searched further, and found the nest of the sandpiper hard by. A less experienced individual would have been contented with his first find, and set down the dunlin's eggs as varieties of the purple sandpiper. It is also a fact that many birds will lay in old nests of other species. Eider ducks' eggs have been found in gulls' nests. The smaller *Falconidæ* are not above occupying the nests of the crow tribe. The sparrow will oust the martin from her laborious edifice. Then we have the parasitic birds—cuckoos, and the cowbird of America. As a rule, the intruder's egg can be readily enough distinguished from those of the lawful inmate, but—with some of the cuckoos at any rate—it is a fact that their eggs have come to resemble those of the foster parents in an astonishing manner, possibly because the parasite will always quarter its eggs upon individuals of its own foster species. Mr. Howard Saunders told me that when nesting in Malaga, he was surprised to find numerous nests of the Orphean warbler with one, or even two, apparently double-yolked eggs; but noting the prevalence of cuckoos (*C. canorus*) in that neighbourhood, he soon satisfied himself that this bird was responsible for the large eggs. They resembled those of the Orphean warbler so closely that it was only by microscopic examination of the texture of the shell that Mr. Sorby, F.R.S., was enabled to corroborate Mr. Saunders' supposition. Having thus exposed a few of the snares that beset the collector in his efforts after identification, it now remains to discuss the light thrown on ornithology, and even the wider domain of natural selection with its side issues, by a study of fully authenticated eggs.

Oology as a Guide in Classification.—Prof. Newton avers that ornithologists achieved a signal triumph when the study of eggs led them to appreciate the intimate relation of the snipes and plovers (*Limicolæ*) with the gulls (*Gaviæ*) before any taxonomer had arrived at that conclusion, which, now that other testimony has assured it, appears obvious on a casual comparison of eggs and nidification. The one marked distinction appears to lie in the number of eggs laid, which, with the *Gaviæ*, rarely exceeds three, while the *Limicolæ* generally lay four. But this numerical difference is by no means constant, and, apart from it, the likeness between some of the terns' and sandpipers', godwits', curlews', gulls', and skuas' eggs is remarkable enough to make an amateur wonder that, on that evidence alone, there could have been any hesitation in accrediting the orders with the closest affinity. But when one remembers that the owls and woodpeckers, also of different orders, resemble each other very closely in the absence of nidification, and the number and appearance of their eggs, one feels it well to pause before relying entirely on that evidence. For all that, eggs have proved most useful finger-posts. Witness the Icterine warbler, classed by Linnæus with the *Motacillidæ*. Not until the unmistakable and intensely characteristic eggs of the bird were found was it relegated to its proper genus. Perhaps in no other family do the egg variations correspond so uniformly with the generic divisions as in the *Sylviadæ*.

It is remarkable, too, how sharply the *Falconidæ* are separated by the character of their eggs, both as an order and in their genera. The peculiar rusty, dried-blood colour of their markings rarely varies in hue, though it does so in tone; and although the spots or splashes may be of the faintest, as in the griffon vulture, the white-tailed eagle, and others, yet they are nearly always present. I need not point out the sharp distinction between the deep-red eggs of the falcons proper and the greenish white products of the harriers, except to suggest that the sparrowhawk, with its clouded eggs, occasionally suffused all over, would seem to form a connecting link between the two. Also it is pleasing to note how closely the magnificent individuality of our own honey buzzard's eggs is reproduced in those of his Transatlantic brethren, the American *Pernis*.

Again, all the owls, without exception, lay pure white eggs, and build no manner of nest. In these particulars, but in no others, they resemble the woodpeckers and parrots, especially the latter. It is possible that a similarity of eggs may point to some remote relationship, some common ancestry; and it is not improbable that birds laying glossy, globular eggs may be descendants from a common ancestral centre, partaking of the nature of owl, parrot, woodpecker, and kingfisher.

The eggs of Pallas's sand grouse are similar to those of certain species of goatsucker. The bird itself is a most distracting blend of grouse and pigeon, but its eggs are quite distinct from those of the game birds, in that they possess a second set of markings—like those of the plovers—which the eggs of true game birds (grouse, etc.) do not. The plovers mostly lay four eggs, the sand grouse and pigeons two. But of the plovers, several—the coursers and pratincoles to wit—rarely lay more than two eggs, and the dotterel always three; while the sand grouse, frequently, and the pigeon, exceptionally, lay three. The nightjars, or goatsuckers proper, invariably lay two eggs on the ground, with no pretence at a nest. The sand grouse does the same. But the owlet nightjars lay white eggs in holes of trees, and the Australian frogmouths (*Podargidæ*) form a kind of pigeon-like nest, in which they deposit two white eggs. Here we have a strong link 'twixt goatsucker and pigeon, while, in the respect of colouring, there is a wonderful resemblance between the eggs of goatsucker and sand grouse. Certain Indian nightjars lay eggs which could be easily mistaken for those of sand grouse. Then the eggs of all three families are so similar to each other in shape, so distinct from all besides. The sides are straight, or nearly so, and the ends equally rounded. The pigeon's eggs curve slightly more than those of the other two. To form a deduction from these data as to the possible relationship between birds so dissimilar in their structure, appearance, and habits, is one of the many problems that confront him who would classify birds by their eggs.

I would add a few remarks on the decided way in which a bird will vindicate its individuality by its nidifica-

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tion, while almost forswearing it in externals, and show how there exists a subtle but rigid distinction between eggs apparently exactly alike. Of the first, I will cite the instance of the reed and marsh warblers, which, in plumage and form, are so exactly alike as to puzzle all but the most gifted taxonomers: the same is the case, though to a less extent, with the willow and wood wrens, and chiffchaff. But the eggs and nests of all these differ unmistakably and strongly. Again, for many a year the bearded reedling (*Panurus biarmicus*) was placed with the titmice as a *Parus*, on grounds which appear very insufficient. But, at last, the eloquent but silent appeal of its nest, like a miniature coot's, and of its eggs, quite unlike any other bird's with which I am acquainted, has procured it not only a separate genus, but a separate family.

To show how eggs apparently indistinguishable by the eye may yet possess indisputable points of difference, I may mention the smew's and wigeon's. The genuine eggs of the former bird were, until very recently, extremely rare. I had the good fortune to obtain a nest with the characteristic grey down, ten eggs, and the skin of the old bird, from Lapland direct, and could verify for myself the diagnoses of authorities on this point. I found that in every case the egg of *M. albellus* weighed over two and a half scruples, which no wigeon's egg in my collection reached by an eighth of a scruple. The thickness of shell to which this extra weight is due, and which is characteristic of all the eggs of the genus *Mergus*, attains its maximum in those of the hooded merganser, which, with the same cubic capacity as those of the wigeon, weigh nearly half as much again.

But not only by relative weight can the smew's eggs be differentiated from those of other ducks: the texture is unmistakable to a practised touch. After several essays, I could pick out smews' from wigeons' in the dark, by passing my nail along the surface, which in the former was smooth and waxy, in the latter offering perceptibly more resistance.

Colouring of Eggs.—This, as is well known, is due to the ejection, from certain glands, of pigment upon the egg as it issues from the oviduct. That it generally does so broad end foremost may be inferred from the fact that in most cases the pigment is concentrated at the larger extremity, often in the form of a corona. Sometimes, as with the sparrowhawk, the reverse is the case. I had a clutch of seven in which the first egg (presumably) had a splendid corona on the large end, which shifted gradually down to the last egg, which had a little blotch on the narrow end. Sometimes all the colour will be bestowed upon the first egg of a clutch, leaving none for the others.

The point, however, that would bear considerable elucidation is the cause of redundance or entire absence of pigment in the eggs of certain classes of birds. As a rule, it will be found that the families of birds laying white eggs are conspicuous for the brilliant colouring or metallic lustre of their plumage, like the parrots, toucans, pigeons, kingfishers, bee-eaters, humming birds, and woodpeckers. It would seem as if so much pigment were expended upon the feathers as to leave none for the eggs. But against this theory comes the evidence of the owls, who certainly are amongst the dowdiest of birds, yet lay uniformly white eggs. It has been stated that those eggs are white which, being laid in the dark, have no need of protective colouring. But how would this theory account for the fully exposed yet white eggs laid by the ducks, goshawks, harriers, and many others? Or, conversely, such birds as *Phylloscopus* and *Cisticola*, which lay coloured eggs in the dark, and the latter of which tints hers with every conceivable variety of spot and colour? It may be that the birds' habits have been suddenly and forcibly changed, without any pressing inducement to change its procedure. Possibly were the fantail (*Schœnicola*) to be coerced to lay in the open, the lighter varieties of its egg might be ultimately eliminated, and the most suitable colour permanently adopted. It may be also, as with the tree pipit, that some species are for ever "harking back" to some ancestral idiosyncrasy.

It cannot be questioned that the colouring of eggs is in a large number of cases wonderfully protective. Those who have looked for the eggs of plovers, oystercatchers, or coursers, can testify to the great difficulty of detecting them amid their surroundings. But he who, on the strength of these instances, would set up to be an absolute "protectionist," would find it difficult to account for such a "free-trader" as the goatsucker, who will display her marble eggs upon a background of fern or bark, admirably calculated to show them up. Yet he may solace himself with the reflection that this class of bird does not fly by day, but sits perfectly close, and in plumage so absolutely resembles her environments as to defy detection.

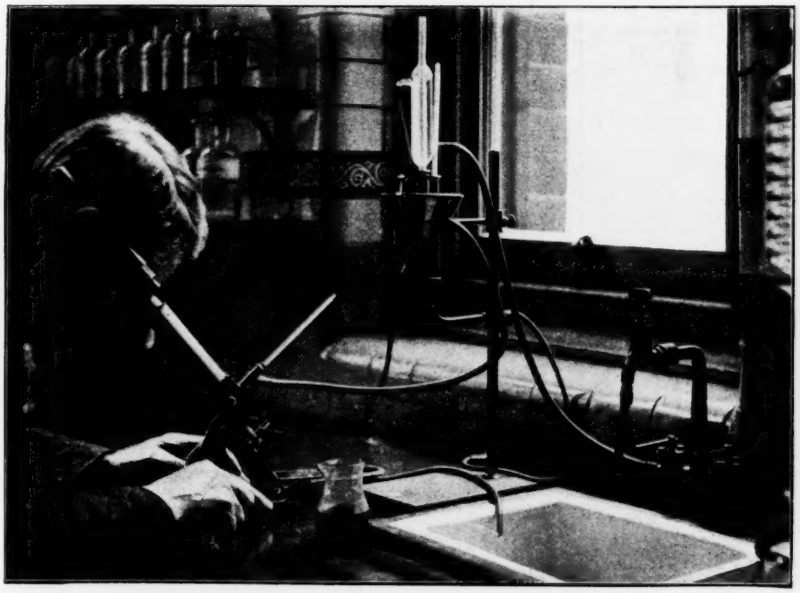
A final question. Does any bird lay an egg resembling that of a reptile sufficiently to warrant the presumption of a closer approach on its part to the line of demarcation between the two classes—the scientific frontier, so to speak, on which stands, weird and solitary, the mystic Archæopteryx? If the thrush, in its form, song, nest, and eggs, be regarded in all respects as the most perfect type of a bird, then we might take the penguin as representing the other extreme, as it has fins for wings, scaly feathers, spends the bulk of its time under water, cannot fly and hardly walk, and lays its egg on the bare rock. That is so; but, unfortunately, it only lays one egg, and the reptiles are conspicuous for their enormous productiveness. On the other hand, the ostriches, like their giant fossil ancestors, lay a number of eggs, and incubate them vicariously in the sun-heated sand—a very reptilian habit.

I will conclude, as I began, with a quotation from Seebohm, one of our greatest oologists: "The new impetus given to the study of all branches of natural history by the discoveries of Darwin and Wallace, has at length reached oology, and an additional interest is given to it from the light which it throws in many cases upon the relationship of species and genera."

## THE NEW STATE LABORATORY.

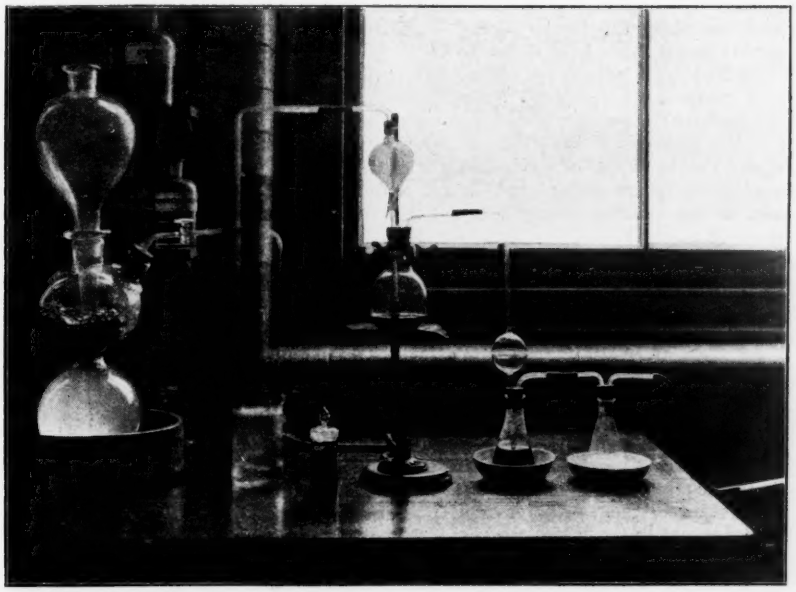
VERY little, indeed, was known, among the general public, of the chemical operations which have, for half a century, been carried on in makeshift rooms at Somerset House, until the new Laboratory was opened in Clement's Inn Passage on the 1st October; and, if possible, less was known of the real functions of such an institution. When the expense of a luxurious public establishment for carrying on chemical manipulations is placed before the groaning taxpayer, one might ask, not unreasonably, what is the use to the people at large of such an accessory in the State machinery? Moreover, evidence is not wanting that, in spite of the great increase in the diffusion of knowledge in recent years, there are not a few among even those who wield considerable influence in municipal affairs who see no use at all in public laboratories, except as a means of increasing unduly the demands on the private householder's pecuniary resources. A lamentable exemplification of this short-sighted policy is even now too apparent in the calamity which has overtaken the inhabitants of Maidstone. This town has enjoyed the reputation of being a healthy locality with a low death-rate and an enviable freedom from typhoid fever—circumstances which, when the first

cases of the epidemic became known, pointed to some specific and serious sanitary defect, and no time was lost in endeavouring to trace the source of the mischief. By this time all the world knows that a more striking instance of guilt has never before been brought home to a particular water supply, and it is generally agreed that such a water should be condemned on half the evidence available in this particular case. Now that it is too late, the indignant ratepayers demand the punishment of those who are responsible for the calamity, and mutual recriminations are rife.



Apparatus for observing the Refractive Index of Butter and like substances.

Originally the Government Laboratory was established for the purpose of assisting the authorities in collecting and protecting the revenue derived from excisable and dutiable articles. How effectively this laudable aspiration has been realized is clearly seen in the results which attended the change in the method of testing imported spirits in 1881. Previous to that date the practice was to assess the duty solely by means of the hydrometer, a method which fails to indicate the true percentage of spirit in most cases when colouring or sweetening matter is present; by substituting the method of testing by distillation, a saving of about one hundred and eighty thousand pounds was effected in the Customs revenue.



Estimation of Sulphur in Steel. (Special Method.)

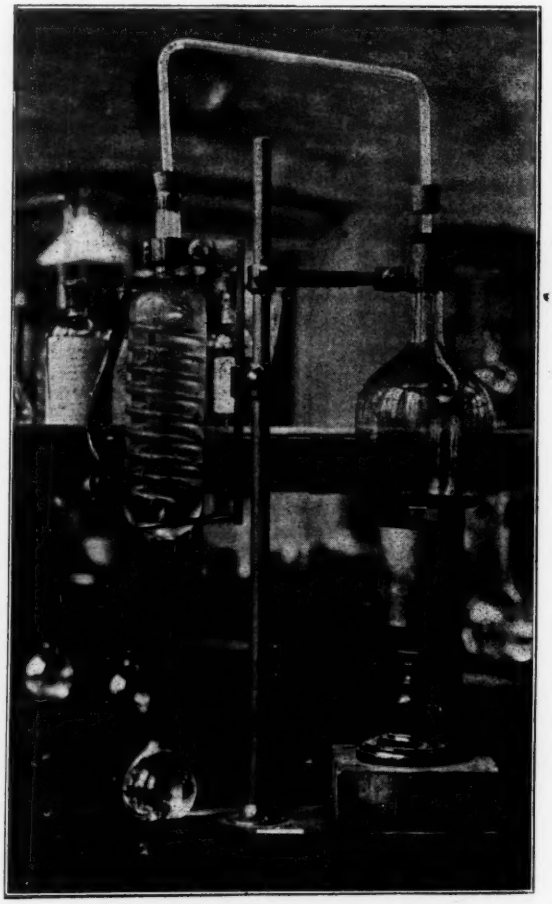
In the year 1853 a gentleman obtained a patent for an artificial lubricant as a substitute for sperm oil, and therefore applied to the authorities to be allowed to use spirit in the manufacture of his lubricant duty free. This led to an extensive series of experiments by the late Mr. Phillips, having for its object the rendering of the spirit unfit for drinking purposes without danger to the revenue derived from potable spirits, and at the same time enabling the manufacturer to compete successfully with the foreigner, either at home or abroad, by placing spirit within reach at about three shillings and sixpence per gallon. He suggested that the addition of crude wood naphtha to spirit of wine would deter habitual drunkards from intoxication at a cheap rate by means of this mixture. Profs. Graham, Hofmann, and Redwood, to whom the suggestion was referred, reported that a mixture of ten per cent. of purified wood naphtha with spirit of wine would effect the object in view. The measure has been highly beneficial. It has deprived the smuggler of a market for his spirit, and the result is that illicit distillation is all but extinct in England. While, however, the interests of the people at large are jealously guarded by our official chemists, the small vendor sometimes finds himself in an unenviable position; indeed, it is an easy matter for a salesman realizing a profit of three or four pounds a year on an article to find himself called upon to pay a fine of three times that amount for an offence which, in some cases, can hardly be regarded as premeditated. A chemist was prosecuted at Hull by the Board of Inland Revenue for selling a spirituous preparation called

"morning tonic," or "pick-me-up," the point at issue being whether the preparation was a medicine or a beverage. A chemist at Sunderland, not being licensed for the sale of methylated spirit, was asked for a gill by an Inland Revenue officer, and said he must put something in it before he could sell it. He added some resin, but according to the evidence for the prosecution did not add in the proportion of three ounces to the gallon—the regulation amount.

The formalities to be observed when a purchase is made for the purpose of analysis, either by a private individual or an officer, must be rigidly observed. The person purchasing any article with the intention of submitting the same to analysis shall, after the purchase shall have been completed, forthwith notify to the seller, or his agent selling the article, his intention to have the same analyzed by the public analyst, and shall offer to divide the article into three parts, to be then and there separated, and each part to be marked and sealed, or fastened up in such a manner as its nature will permit; and shall, if required to do so, proceed accordingly, and shall deliver one of the parts to the seller or his agent. He shall afterwards retain one of the said parts for future comparison, and submit the third part, if he deem it right to have the article analyzed, to the analyst.

On entering the main laboratory a scene of extreme activity presents itself, and one is almost bewildered by the variety of operations in which the many chemists are continuously engaged. The profuse distribution of bottles of all kinds of alcoholic drinks, tinctures, etc., on the top shelves of the benches, and the manner in which the malt liquors are being transferred from vessel to vessel, gives one the impression of a busy bar in some public-house. A little friendly explanation, however, from the courteous and extremely intelligent workers, eliminates much of the mystery with which the processes are at first sight invested. The operation of "tossing" beer, for example, is performed for the purpose of extracting the free carbonic acid locked in the liquid during fermentation. As the beer is poured from a great height an abundance of froth rises to the surface, and, as the bubbles break, carbonic acid escapes. A measured quantity of the beer is then weighed for the purpose of determining its specific gravity, and it is then put in a still, by which means the alcohol, under the influence of heat, distils over into a receiver, the boiling point being much lower than that of water. In this way a distillate is obtained richer in alcohol than the original beer, and the distillate, when weighed in the balance, indicates a different specific gravity, which enables the chemist to compute the percentage of alcohol in the sample of beer under examination, account also being taken of the solid residue left in the still.

In another laboratory an assistant may be seen investigating, say, samples of butter. How can he detect foreign matter? One method is by means of a specially constructed microscope. The pure article, when melted and a ray of light passed through it, has a definite refractive index for a given temperature, and when foreign matter is present the refractive index varies according to the nature of the substance added. Hence, a sample of butter is put in the instrument, and melted by water from a conical vessel introduced into a jacket in the microscope by means of tubing. The temperature is then registered by a thermometer, and the refraction is read off on a graduated scale in the field of view. Again, a sample of steel may be under examination for sulphur, and if more than a regulation amount is found the steel is condemned as unfit for a particular purpose. The steel, as filings, is dissolved in acid in a flask, by which means the sulphur in it is set free, and this free sulphur is converted into sulphuretted hydrogen by means of a current of hydrogen urged through from a Kipp's apparatus, the hydrogen being washed from impurities on its way to the flask by a proper solvent in a Wolf's bottle. The sulphuretted hydrogen thus formed passes onwards to another flask containing lead nitrate, by which means lead sulphide is formed. By means of an oxidizing agent this lead sulphide is converted into lead sulphate, a definite compound in which the proportion of sulphur is known. And so the sulphur which before existed in the steel in an unknown proportion, is now united with lead in such a ratio as admits of computing its proportion in the original sample of steel, a definite weight of the steel having been taken for analysis.



Still, used in distilling Alcoholic Liquids.

The work of the institution is divided into four distinct departments: (1) the main laboratory, wholly reserved for the analysis of alcoholic products—beer, wines, tinctures, rum, brandy, etc.; (2) the tobacco rooms, fitted with appliances for the examination of manufactured and the so-called "offal" tobacco, for the determination of fraudulent or improper admixtures; (3) the Board of Agriculture Department, where all cases of disputed analyses of fertilizers, feeding stuffs, etc., are referred by magistrates, and on which the decision of the Principal Chemist is final; (4) the Crown contracts laboratories, in which all manner of substances may from time to time be examined—from

steel rails for railways to the gilt buttons and gold lace on the uniforms of our naval and military grandees.

Chemical laboratories, of course, bear a close resemblance to each other, but there are several reasons why the one at Clement's Inn Passage should be, to some extent, familiar to all dwellers in these isles. (1) It is a factor, however small or indirect, in our daily lives; (2) we have to pay for it, and should therefore know what we are to receive in return for the outlay; (3) it is unique of its kind, and includes in its construction all the best features of other existing laboratories, totally ignoring all their defects, for which happy result we are indebted to the wide experience and unerring judgment of Dr. Thorpe, the Principal Chemist. For instance, the laboratory has fully developed respiratory organs, provision being made for the proper circulation of fresh air; and the fume closets are all connected by internal passages in the walls with a sort of large duct, through which a fan, worked by a silent engine, draws the noxious vapours forward, and delivers them into the atmosphere outside the building. Its arterial and venous systems are thoroughly differentiated —the water polluted by operations in the laboratory being delivered through separate channels to the drains, while the aqueous liquid used as water-jackets for the distillations is carried through separate channels, and lifted by a force pump into cisterns above the building, to be used over and over again, and the water so used is kept cool by brine communicating with a refrigerating apparatus. The internal walls, in keeping with chemical operations, are enamelled, and there is a cool room for preserving samples of alcoholic drinks, etc., in which as you enter you feel a sort of pressure at every point of the body—a grip all round—so intense is the cold, a condition favourable for retaining fermented liquors in their original condition; while last, but not least, the laboratory is illuminated by electricity. J. MILLS.

## THE FACE OF THE SKY FOR NOVEMBER.

By HERBERT SADLER, F.R.A.S.

SOME well-marked groups of spots and faculæ have lately appeared on the solar surface.

Conveniently observable minima of Algol occur at 9h. 47m. P.M. on the **15th**, and at 6h. 40m. P.M. on the **18th**.

Mercury is too near the Sun for observation in November.

Venus is a morning star, and is fairly well situated for observation this month. On the **1st** she rises at about 4h. 30m. A.M., with a southern declination at transit of 4° 24′, and an apparent diameter of 11½″. On the **7th** she rises at 4h. 45m. A.M., with a southern declination of 7° 15′, and an apparent diameter of 11¼″. On the **12th** she rises at 5h. A.M., with a southern declination of 9° 33′, and an apparent diameter of 11″. On the **17th** she rises at 5h. 15m. A.M., with a southern declination of 11° 46′, and an apparent diameter of 10¾″. On the **22nd** she rises at 5h. 32m. A.M., with a southern declination of 13° 53′, and an apparent diameter of 10¾″. On the **30th** she rises at about 6h. A.M., with a southern declination of 16° 56′, and an apparent diameter of 10½″. During November she describes a direct path through the eastern portion of Virgo into Libra, being not far from α Libræ on the **24th**.

Mars is in conjunction with the Sun on the **21st**.

Jupiter is a morning star, rising on the **1st** at 3h. 15m. A.M., with a northern declination at noon of 0° 39′, and an apparent equatorial diameter of 32½″. On the **7th** he rises at 2h. 57m. A.M., with a northern declination of 0° 13′, and an apparent equatorial diameter of 32½″. On the **12th** he rises at 2h. 43m. A.M., with a southern declination of 0° 8′, and an apparent equatorial diameter of 32¾″. On the **17th** he rises at 2h. 28m. A.M., with a southern declination of 0° 28′, and an apparent equatorial diameter of 32¾″. On the **23rd** he rises at about 2h. A.M., with a southern declination of 0° 51′, and an apparent equatorial diameter of 33″. On the **30th** Jupiter rises at about 1h. 45m. A.M., with a southern declination of 1° 15′, and an apparent equatorial diameter of 33¼″. He describes a direct path in Virgo during the month.

Saturn is in conjunction with the Sun on the **25th**, and Uranus is in the same position on the **21st**.

Neptune is an evening star, and is well situated for observation, rising on the **1st** at 6h. 32m. P.M., with a northern declination of 21° 50′, and an apparent diameter of 2½″. On the **11th** he rises at 5h. 53m. P.M., with a northern declination of 21° 49′. On the **21st** he rises at 5h. 13m. A.M., with a northern declination of 21° 48′. On the **30th** he rises at 4h. 37m. P.M., with a northern declination of 21° 47′. During the month he describes a short retrograde path in Taurus.

November is a very favourable month for shooting stars. The most marked display is that of the Leonids on November **13th** and **14th**, the radiant point being in R.A. 10h., and northern declination 23°. The radiant point rises at about 10h. 15m. P.M. The Andromedes occur on the **27th**, the radiant point being in R.A. 1h. 40m., and northern declination 43°.

The Moon enters her first quarter at 2h. 37m. P.M. on the **1st**; is full at 9h. 50m. A.M. on the **9th**; enters her last quarter at 2h. 2m. P.M. on the **17th**; and is new at 9h. 20m. A.M. on the **24th**.

A maximum of the variable star ο Ceti will occur about the **9th**.

## Chess Column.

By C. D. LOCOCK, B.A.Oxon.

Communications for this column should be addressed to C. D. LOCOCK, Burwash, Sussex, and posted on or before the 10th of each month.

*Solutions of October Problems.*

No. 1.

(By J. K. Macmeikan.)

1. Q to R8, and mates next move.

No. 2.

(By P. F. Blake.)

1. R to K7, and mates next move.

CORRECT SOLUTIONS of both problems received from J. T. Blakemore, G. J. Newbegin, G. Coules, E. C. Willis, G. G. Beazley, W. Clugston, W. de P. Crousaz, Kappa, J. McRobert, H. H. Thomas, Alpha, E. W. Brooke.

Of No. 1 only, from M. Wiedhofft.

Of No. 2 only, from Captain Forde.

*M. Wiedhofft.*—If 1. B to B4ch, Q × R.

*Captain Forde.*—In answer to 1. Q to R6, the King can move.

*G. Coules.*—Your solutions of September problems were correct, but arrived too late to be acknowledged last month.

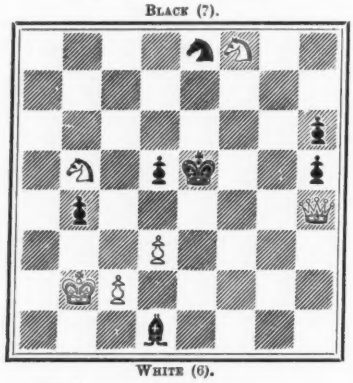
*A. C. Challenger.* — Many thanks for the substitute, which arrived just in time to save inquiry as to the flaw in the other.

## PROBLEMS.

### No. 1.

By A. C. Challenger.

BLACK (7).



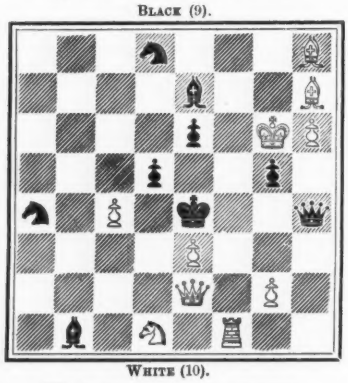
WHITE (6).

White mates in three moves.

### No. 2.

By Geo. J. Slater, Bolton.

BLACK (9).



WHITE (10).

White mates in two moves.

[The above was bracketed second-prize winner in the *Leeds Weekly Mercury* Tournament.]

## CHESS INTELLIGENCE.

The International Tournament at Berlin last month resulted as follows:—

| | |
|---|---|
| First Prize.—R. Charousek ... ... | 14½ |
| Second Prize.—C. A. Walbrodt... ... | 14 |
| Third Prize.—J. H. Blackburne ... | 13 |
| Fourth Prize.—D. Janowski ... ... | 12½ |
| Fifth Prize.—A. Burn ... ... ... | 12 |

The Sixth and Seventh Prizes were divided between S. Alpin, G. Marco, and C. Schlechter, who each scored 11½.

The other scores (not counting those of Herren Albin, Englisch, and V. Bardeleben, who retired through ill health at different stages of the tournament) were H. Caro, 11; M. Tchigorin, 10½; E. Schiffers, 10; J. Metger, 9; W. Cohn and S. Winawer, 8½; H. Suchting, 8; R. Teichmann, 7½; A. Zinkl, 6½.

Herr Schiffers obtained the special prize for the best score against the prize-winners.

The contest, as will be seen, was very close. Herr Charousek, who started badly, afterwards scored win after win in fine style. There is nothing surprising in his victory; probably he and Janowski and Tchigorin, who was evidently out of form, were the favourites before the tournament began. Walbrodt played consistently throughout, and did not lose a game to any of the first ten. Mr. Blackburne—inspired, no doubt, by the scene of his great triumph in 1881—made a capital start; and though he afterwards drew too many games to repeat that victory, he lost only to Winawer and Walbrodt. Mr. Burn also did well, though he lost five games. Schlechter lost only to Burn and Marco, but as usual he drew a very large proportion of his games—in this case, no less than eleven. Marco was leading during the earlier part of the tournament, but he gradually dropped back into his proper position. Mr. Teichmann's performance was again very disappointing, though he did better than last time.

Immediately after the tournament M. Janowski challenged Herr Walbrodt to a match, but the challenge was not accepted. The next international tournament will be held at Vienna next year, when very valuable prizes will be offered.

The Minor Tournament at Berlin was won by Herr V. Popiel, who did not lose a single game. The winner was at one time a very unsuccessful competitor in first-class tournaments, and has evidently improved since then.

It is stated that the inventor of the Steinitz gambit, as the result of a single defeat, has admitted the unsoundness of that interestingly eccentric *début*. It is probable, however, that a good deal more than this must happen before he finally despairs of his favourite.


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PLATE.—Venus in 1897.


## *NOTICES.*

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XUM

XUM

KNOWLEDGE
LITERARY SUPPLEMENT

## THE STUDY AND USE OF SCIENTIFIC LITERATURE.

THE great difficulty that besets both the professional and the amateur student of natural science at the present day is to find out what has already been written on the subject he may have in hand. And the difficulty is the greater in the case of the amateur, because the professional, who is nowadays generally a specialist, has by long training learnt how to lay his hand on most of the literature bearing upon his own particular branch of study—or, at all events, knows the best way of finding out desiderata.

Apart from the enormous volume of scientific literature annually poured out by societies in all parts of the globe and in all languages, one great reason why the study and use of such literature is so difficult is due to the fact that scarcely one society in the zoological division keeps to any one particular subject. To take our own country, we have the Zoological Society not only publishing descriptions of animals and papers on their geographical distribution, but others on anatomy and palæontology. But the Linnæan, which is primarily a botanical society, likewise publishes zoological papers; and the Geographical has lately taken to include memoirs on the distribution of animals. Anatomical papers are published by the *Journal of Anatomy and Physiology*, while the *Annals and Magazine of Natural History* sends forth a monthly *mélange* on all kinds of biological subjects. As regards palæontology, the Palæontographical Society is specially devoted to this subject, but a large number of papers appear in the publications of the Geological Society; while stratigraphical geology is represented not only in these volumes, but in the issues of the Geologists' Association and a host of provincial societies. Then, again, we have the Royal Society, which is supposed to suck the cream of all the scientific discoveries of each year, and whose publications consequently contain papers on almost every conceivable scientific subject. Much the same scattered distribution of papers occurs in the case of botany, chemistry, and astronomy. And when we remember that British memoirs form only a very insignificant moiety of scientific literature, and that the same mixture of subjects occurs in the publications of foreign learned societies, the amateur student may well be appalled at the difficulty of obtaining an adequate knowledge of the literature of any particular branch of science.

Although it would, of course, have no effect on the past, it would undoubtedly be a vast advantage to science if the various learned societies of each individual country could agree among themselves to restrict their own publications to one particular subject, so that in each country there would be one particular journal where we should find all the zoological information, another the geological, a third the botanical, a fourth the chemical, and so on. But this consummation, however devoutly to be wished, is one we are not likely to see realized for many a long day, and we must perforce make the best of things as they are.

To remedy this state of chaos has been and is one of the great objects of many of the learned bodies of the present day. And the only way in which this can be done is by publishing annual records of the work accomplished in each and every branch of science. The *magnum opus* of this nature in Britain is the Royal Society's "Catalogue of Scientific Papers," which is now approaching within measurable distance of being up to date, but which has the serious drawback of only containing a list of papers arranged under the heading of authors, without any subject index. In certain branches of science there are, however, admirable records now published, containing not only references to papers arranged according to authorship, but also classified under subjects. One of the foremost of these is the *Zoological Record*, and a few years ago we had the equally valuable *Geological Record*, although this unfortunately came to an end in 1889. To fill its place, the Rev. Mr. Blake started in 1890 the *Annals of British Geology*, a work admirable so far as it goes, but necessarily imperfect, as it deals only with papers bearing on the geology and palæontology of Britain, and geological and palæontological papers published in this country. More recently the Geological Society has started another record, but this is, unfortunately, limited to the works contained in the Society's library, and therefore fails to meet all the wants of writers. Moreover, both these records deal with palæontology, which is also treated of to a certain extent in the *Zoological Record*, so that much valuable space and time are wasted. It is to be hoped that in the near future the two societies will arrange between them that this subject is taken in hand by one only, and then done completely. Records—more or less nearly approaching completeness—are also undertaken by the Chemical, Meteorological, and other societies. Messrs. Cassell's *Year Book of Science*, which enjoyed a too brief existence in the earlier years of the present decade, was intended to provide a more popular guide to scientific literature of all kinds, and ought to have been of great use to the amateur worker. Unfortunately there appear too few of the latter class to support the cost of publication of such a work, which is necessarily heavy.

At the present day a record "made in Germany" is ahead of any of our own, since index-slips on any scientific subject are now supplied by the Bureau of Scientific Literature at Berlin, and are issued at the shortest possible interval after the date of publication of the memoirs. There are, however, hopes of better things ahead, the



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Royal Society being now engaged on a scheme for an International Record of Scientific Literature which shall deal with every subject in a complete and exhaustive manner; subject indices being an essential part of the scheme.

But records of scientific literature are, after all, only useful to those who have access to large libraries, where the memoirs quoted may be found; and there is a large class of scientific readers and students who depend more or less entirely for their information on text-books and such like. And no one can say that at the present day the supply of such works is not fully adequate to all needs. In many branches of science, such as zoology, palæontology, the geographical distribution of animals, the origin of species, chemistry, and geology, such text-books, if fairly well up to date, ought to give the worker a good general idea of the subject treated. But science is ever advancing, and it is but very rarely that a student can depend on the information in a text-book for determining whether or no any fact he may have discovered for himself is really new. It must also be borne in mind that the author of a text-book is nowadays very seldom an expert in the whole of his subject, and that consequently some portions of his work are far less valuable than others. Then, again, there are different grades of such works. For instance, the ordinary popular natural history is but too frequently regarded as if it were a scientific treatise of high and original value, whereas it is, from the necessity of the case, mainly or partly a mere compilation. Between such a work and a strictly scientific treatise stand memoirs like Sir William Flower's article "Mammalia" in the "Encyclopædia Britannica," which, although now somewhat out of date, may be appealed to with more confidence. The highest zoological treatises, which contain all the available information up to the date of publication, are, however, the British Museum's "Catalogues" of animals, living or extinct, which now form a most extensive series, although far less well known to the ordinary amateur worker than they should be. In some groups these invaluable publications are, unfortunately, far behind date, but in groups where volumes have recently been issued the task of the student is an easy one. He has but to make himself acquainted with all the information on the subject he may require from the "Catalogue," and then turn to the *Zoological Record* for subsequent years to find if anything fresh has been recorded. And, this being done, he will be in the proud position of knowing all that is worth knowing regarding his particular line of study. Would that we could say there were the same facilities in other sciences! R. LYDEKKER.

## REVIEWS.

*Reports of the Smithsonian Institution, 1894, 1895.* (Washington: Government Printing Office.)

*Report of the United States National Museum.* (Washington: Government Printing Office.)

IT behoves all men of science to give thanks for the existence of the Smithsonian Institution, for certainly no organization in the world works more extensively, or so well, for the advancement of scientific knowledge. Before us we have two bulky volumes, running into sixteen hundred pages altogether, and constituting the Smithsonian Reports proper for the years 1894 and 1895, while a third volume, containing more than one thousand pages, is the Report of the United States National Museum (which is under the direction of the Smithsonian Institution) for the year 1894. It will be evident that the contents of works of such a voluminous character as these cannot be adequately described in the brief space of a review; it is, indeed, impossible to refer to a tithe of the contributions included in these weighty tomes.

What makes every Smithsonian Report a desirable possession to a man of science is not so much the report of the secretary upon the operations and conditions of the Institution (if Mr. S. P. Langley will pardon us for saying so) as the general appendix, which is usually seven or eight times larger than the administrative statement. The appendix to each Report comprises a collection of miscellaneous memoirs on scientific subjects selected from periodicals published in various parts of the world, and possessing interest for all who are engaged in the promotion of natural knowledge. Reprints or translations of thirty-seven memoirs of this character, covering a variety of subjects in physical and natural science, appear in the Report for 1894, and thirty in the Report for 1895. Several of the memoirs in the latter volume are essays upon the properties of atmospheric air, sent in to compete for the Hodgkins Fund prizes of ten thousand, two thousand, and one thousand dollars respectively. It will be remembered that the first prize was awarded to Lord Rayleigh and Prof. Ramsay for the discovery of argon. The second prize was not awarded, and the third went to Dr. H. de Varigny, of Paris, for an essay entitled "L'Air et la Vie," a translation of which is given in the Report.

Leaving the Smithsonian Reports with a feeling of dissatisfaction at not being able to do justice to their comprehensive and most valuable contents, we come to the Report of the United States National Museum. In addition to a review of the work of the different scientific departments of the museum during 1894, the Report contains six papers describing and illustrating some of the collections. One of these, on "Primitive Travel and Exploration," by Dr. O. T. Mason, is a volume in itself, for it covers three hundred and fifty pages, and contains a mass of interesting information on the origins of inventions. Another long memoir is on "The Swastika, the Earliest Known Symbol, and its Migrations," by Mr. Thomas Wilson. The swastika is the most ancient sign of the cross. Despite the theories and speculations of archæologists, the origin of this sign is unknown, and it is properly classed as prehistoric. Mr. Wilson's aim has been to bring together information as to the distribution and use of the swastika sign, but he does not discuss its origin or original meaning. "Mancala, the National Game of Africa," is described by Dr. Stewart Culin, and various forms of the board used in the game are illustrated. Mancala is played wherever the Arab has penetrated. It is played by boys in the streets of Cairo, by guides on the top of the pyramids at Ghizeh, by the Kaffirs in the diamond compounds of South Africa, and, in fact, it has for ages diverted the population of nearly half the inhabited area of the globe. The game may be likened to the game of draughts, and is played upon a board containing two rows of cup-shaped depressions—at least, so it appears to us. Two players use a certain number of pebbles or shells as counters, and transfer them from one hole to another upon a system not easily explained, and altogether mystifying to an onlooker.

Another paper in the Report of the Museum is on "Primitive Methods of Drilling," by Mr. J. D. McGuire, and all the papers are copiously and brilliantly illustrated. When we remember how liberally the Smithsonian Institution distributes publications of this kind among institutions in all parts of the world, we are afforded a remarkable instance of the international interests of science.

*Life in Early Britain.* By Bertram C. A. Windle. (David Nutt.) Illustrated. 3s. 6d. Of all subjects of historical interest, that which is most involved in mystery and uncertainty is assuredly the life of our remotest ancestors. To the archæologist the subject is of great importance, and to the general reader an inexhaustible source of pleasure. Who were the first occupants of our islands? Some authorities believe that man existed in Britain when the land formed a part of the continent of Europe. Others express a different opinion. In time the land became separated and the island we now know came into existence. The only way that succeeding races could then have come into Britain was by means of boats, or their equivalents. The first of these sea-borne races was the Neolithic, then came the Celts, and as to the succeeding races we need not mention them here. The means by which we have acquired some knowledge regarding the existence of these earlier ancestors are set forth in this little volume. The monuments, implements, and other remains found in different parts of these islands are described by the author in an able and interesting manner, while the engravings are of high quality and aptly descriptive of the text they are meant to illustrate. A comprehensive list of the principal monuments left by our ancestors is given at the end of the book. Prof. Windle, like all other writers on this subject, has, of necessity, drawn largely upon imagination to bridge the chasms and to focus the many divergent rays of light which proceed from so many different sources; and he has, we think, succeeded in presenting an outline picture of primitive life which, in the present state of knowledge, will not only meet with general approval, but also serve as a reliable introduction to students who desire a stepping-stone to more pretentious works of the same character.

Interior of the Roman Bath at Bath. From "Life in Early Britain."

*Hypnotism and its Application to Practical Medicine.* By Otto Georg Wetterstrand, M.D. (G. F. Putnam's Sons.) Price 10s. Hypnotism as a branch of medicine is, in a general way, almost in its infancy, yet the treatment of patients by this method is regarded by some as having a great future in store. The present work has been written by a physician who has during the past few years made a speciality of hypnotic science. In his introduction the author says that the majority of people can be hypnotized; some are easily, and others with difficulty, thrown into the hypnotic state. As a proof of this the author states that out of three thousand one hundred and forty-eight persons acted upon since the year 1887, only ninety-seven were proof against his power or suggestions. Children are, without exception, easy to hypnotize, and subjects up to the age of thirty are not difficult to manage. After this age the susceptibility diminishes, but in very old people the power of hypnotization is great. Cases of all kinds are mentioned, and the results of the author's experiences, as here set down, go to prove that most diseases can be cured by hypnotism! We are told that the diseases which are most susceptible to the hypnotic influence are those which have a nervous origin. Herbert Spencer, in his great work on philosophy, comes to the conclusion that antagonism prevails among different classes of society because they will not take the trouble to look into the matter, and find out both its faults and virtues. Much the same may be said of hypnotism, according to the advocates of this latest universal remedy. It may be almost right, in the light of what past experience has shown, to say that the real worth of a theory is in inverse proportion to its first acceptance. Those who venture to assert that in the future hypnotism will be recognized as the long-sought elixir, as it were, have still some dense mists and fogs to dissipate by the light of science before a belated, and maybe sceptical, public can discern so fair and beneficent a banker of human woe in such a guise. It would, indeed, be a means of dissipating much pain and suffering to poor humanity if it be found possible to cure most diseases by hypnotism.

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## AMERICAN ETHNOLOGY.*

So far as Government recognition is concerned, there can be no question that the science of ethnology occupies a far more important position in the United States than in our own country; and the three magnificent quarto volumes before us afford ample evidence of the thoroughness and soundness with which the Bureau is carrying out the work entrusted to its charge. In having wild Indian tribes living only a comparatively short distance from the seat of government, the United States has naturally a special inducement to undertake ethnological investigations which is wanting in many other countries. Still this inducement—and indeed duty—might well have been overridden by other considerations in a country where commercial business is carried on under high pressure; and it is, therefore, highly to the credit of all concerned that the Bureau has been established, and that its investigations are conducted in such an able manner. The Bureau is fortunate in being under the control of such an accomplished scientist as Dr. J. W. Powell, the Director, who is ably seconded by a most efficient staff. The preparation for publication by a Government department of such a mass of material, and the designing of the plates by which these volumes are illustrated, naturally occupy a considerable amount of time; and it is therefore not surprising to find that the letter of transmittal accompanying the fourteenth report is dated July, 1893, and that with the fifteenth the corresponding month of the following year. The execution of most of the numerous plates, whether plain or coloured, with which the volumes are illustrated, is beyond praise; and the two which we have reproduced on a smaller scale will be found full of interest to our readers.

The limits of our space absolutely forbid any attempt at a critical review of even a few of the numerous separate papers contained in these bulky volumes; and our notice must accordingly be limited to a brief mention of some of the leading objects of the Bureau, and reference to one or two of the most generally interesting memoirs.

The science of anthropology, which comprises in its full extent all that relates to the human race, is divided into the two branches of ethnology and demology (or demonomy); the former of these dealing with man's physical structure, and the latter with his special attributes, such as language, institutions of government, religion, industries, arts, etc. By ethnological characters man is, of course, well separated from the lower animals, and the main groups of the human race inhabiting different parts of the world are also classified in this manner. In the early days of American ethnology (using this term in a wide sense) the attempt was made to classify the various Indian races by the biological method—that is, by different structural details; but it was eventually found that "after the primary division into three, four, or five races, the varietal features afford little or no aid in defining and classifying tribes, so that ethnologic researches on any given continent are necessarily carried forward in accordance with the super-organic science of man." This is, in fact, studying man from his higher attributes alone; and to this line of investigation the main efforts of the Bureau have been directed. How important these investigations have proved from a practical point of view is evident from the discovery

The Ghost Dance.—Inspiration.

From Annual Reports of the Bureau of Ethnology (Smithsonian Institution).

* Annual Reports of the Bureau of Ethnology to the Secretary of the Smithsonian Institution. Vols. XIV. (in two parts) and XV. (Washington. 1896 and 1897.)

that in settling the various tribes on the reserve territories, those that speak similar or kindred tongues, and preserve somewhat similar institutions, are much more likely to dwell in peace than those in which these common factors are wanting.

One very important and interesting line of investigation is the endeavour to eliminate from the study of the Red Man those traits of character and habits acquired since the introduction by Europeans of the horse and iron, and thus to reveal him in his true primitive characters. Not only have the records of the earliest pioneers of civilization been searched and correlated, but laborious investigations have been carried on in the ancient quarries where the Red Man manufactured his weapons and implements in pre-European days. And we now know more or less exactly the manner in which these were made, and the strata from which the material was dug.

A large portion of the fifteenth Report is occupied by a memoir on the ancient stone implements in the Potomac and Chesapeake districts, written by Mr. W. H. Holmes, one of the most painstaking investigators on the survey. A very remarkable and unexpected result of the study of the quartzite quarries of these districts is that the most rudely flaked implements do not represent an extremely low and primitive state of culture, but that they were contemporaneous with the finest stone carving, pottery, and basket and wood work. The author is careful to say that these conclusions relate only to these particular districts, but it is manifest that they will have to be taken into careful consideration with regard to the products of other countries. In another paper in the same volume it is shown that the horse was not introduced among the Sioux Indians till about the commencement of the present century; and also that this tribe possessed several animals in a kind of semi-domesticated state.

But from a popular point of view undoubtedly the most interesting of the whole series of memoirs is the one dealing with the so-called "ghost-dance religion," which occupies the greater portion of the second part of the fourteenth Report, and is the work of Mr. J. Mooney. This strange religious cult, which spread over the Western United States between the years 1889 and 1892 with such startling rapidity, and was closely connected with the great outbreak of the Sioux tribe, was so fully reported in the newspapers of the time that it is doubtless still fresh in the memory of many of our readers. In addition to the rapidity of its spread, the cult was noteworthy on account of its powerful influence on the character and conduct of its devotees. The normal mental processes were suspended, and the ordinary bodily functions dominated for hours or even days. Indians who were ordinarily docile and contented, suddenly became morose and bloodthirsty; while peaceful tribes in an instant broke into open rebellion against the dominant power. Doubtless the peculiar mode of thought characteristic of the Indian generally, his habitual appeals to the unknown for the explanation of simple facts, his habit of peopling his natural surroundings with ghostly imaginations, rendered him peculiarly susceptible to the new cult. To our great regret, space forbids quoting any of the descriptions of the curious ceremonies connected with the ghost-dance, in many of which hypnotism played a very important part. Between thirty and thirty-five tribes, numbering some sixty thousand individuals, seem to have come under its influence. The first of the two illustrations we give represents the devotees engaged in prayer. The portraits of the leaders of the cult, of which there are many in the volume, have an especial value, not only as representing rapidly waning races, but as depicting some of the master minds of each tribe; and of no less interest are the figures of the mystic weapons and symbols employed during the dance.

Hahaíwüqti, Natácka, and Soyókmana (Medicine Men).
From the Fifteenth Annual Report of the Bureau of Ethnology.

With the bare remark that our second illustration represents a group of "medicine men," we are reluctantly compelled to bring to a close our brief notice of a very fascinating series of important memoirs.

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*Wild Norway.* By Abel Chapman. (Arnold.) Illustrated. 16s. Mr. Chapman's books always contain a great deal of information of birds and beasts obtained at first hand, and this makes them of exceptional value to the naturalist. To the sportsman they must always prove interesting, while to the general reader they are too bright and too varied to be anything but good reading. The volume before us is quite equal to those that have preceded it. The author tells us in the preface that this is the last of the series, and we can but regret it. The chapters on reindeer stalking and elk hunting are amongst the best sporting stories we have read. Although the author does not count himself a first-class shot, his bag of six fine reindeer in half a minute, even under the lucky conditions described, was a remarkably good performance. A considerable part of the book is devoted to salmon and trout fishing, which will be of great interest and considerable value to those who have fished or intend to fish in Norway. The book contains several chapters—notably those entitled "Salt-Marshes of West Jutland" and "Impressions of Denmark"—which are well worth the attention of ornithologists. There is also an interesting chapter on bird and insect migration observed on the North Sea. The illustrations, by the author, assisted by Chas. Whymper and P. Ch. Trench, are good on the whole, but some of the figures are decidedly stiff and "wooden."

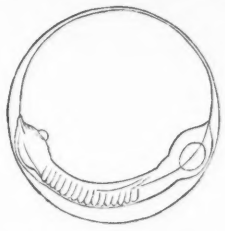
The Sentinel. (Reindeer.) From "Wild Norway."

*A Manual and Dictionary of the Flowering Plants and Ferns.* By J. C. Willis, M.A. Two vols. (Cambridge University Press.) 10s. 6d. This work forms one of the Cambridge natural science manuals of the biological series, and consists of two small volumes of two hundred and twenty-four and four hundred and thirty pages respectively. It is well printed on excellent thin paper, and might have been conveniently put into one volume, and then not have exceeded pocket size. We may say at once that this is a useful and, generally speaking, reliable work, especially the second part or volume, which is the "dictionary" proper, and which we can unreservedly recommend to the young student. Part I., as the author informs us, was written as a supplement to Part II. It is unequal in value in its different parts, and, as must happen in a work covering so wide a field, much has admittedly been borrowed, sometimes from sources not judiciously selected, or the matter not well digested. Still, on the whole, it is an advance on most previous elementary works on botany. The author starts on an evolutionary basis, and he strongly, and, as we think, wisely, insists on the study of the external morphology of plants, preliminary to anatomy and physiology. An introductory chapter consists of suggestions to students as to the method of using his book in connection with the botanic gardens and museums of Kew and Cambridge. This is a new departure, susceptible of further development. For instance, the author might well have directed attention to the admirable instructional series of specimens and models in the botanical department of the Natural History Museum at South Kensington. The introduction is followed by chapters on the outlines of the general morphology and natural history of flowering plants and ferns; on variation, evolution, and classification; on forms of vegetation and the geographical distribution of plants; and on economic botany. Naturally, in so small a space, many of the subjects are only superficially treated. The very condensed sketch of botanical geography is one of the least satisfactory parts of the work, and reminds us of the great want of an up-to-date treatise on this subject in the English language. This, we may add, should not be a translation of any of the existing foreign books, but the work of one of our most accomplished specialists. Mr. Willis finishes with a glossarial index to the English names, technical terms, etc., and he also gives a useful though limited bibliography.

*The True Grasses.* By Edward Hackel. Translated from "Die Natürlichen Pflanzenfamilien" by F. Lawson-Scribner and Effie A. Southworth. Illustrated, (Constable.) 10s. 6d. This little book will be found useful by persons who are desirous of studying grasses, but unable to read either German or Latin; and also by persons who cannot afford the more expensive works. Prof. Hackel is a recognized authority on the classification of grasses, and he has done some excellent work; but it is necessary to state that the present synopsis does not embody the results of his later researches, to say nothing of the work of other botanists. In the first instance it was largely compiled from Bentham and Hooker's "Genera Plantarum" (1883), and originally published in German in 1887, and translated and published in America in 1890. Since the latest of these dates, some important contributions have been made to the literature on grasses—notably Sir Joseph Hooker's elaboration of the Indian genera and species. Briefly, then, this English edition is merely a re-issue of the American edition, which appeared six years ago, and it deals only with genera—not with species.

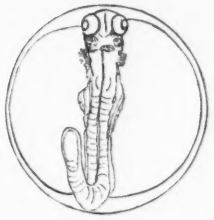
*Elements of Chemistry.* By Rufus P. Williams. (Ginn & Co., Boston and London.) Illustrated. 5s. We are informed that this book is the outcome of the author's wide experience with students of chemical science. He endeavours to treat the subject in an interesting manner, and really makes the study of chemistry a pleasure, and at the same time a mental exercise. The volume is profusely illustrated by excellent outline figures, showing arrangements of apparatus and correct modes of manipulation.

*The Life Histories of the British Marine Food Fishes.* By Dr. W. C. McIntosh, F.R.S., London and Edinburgh, and A. T. Masterman, B.A., B.Sc. (Clay & Sons.) Illustrated. 21s. A few months ago we directed attention to Mr. J. T. Cunningham's remarkably instructive work on "British Marketable Fishes," prepared under the auspices of the Marine Biological Association. We have here a similar but not so popular a volume, emanating from the Marine Laboratory of the University of St. Andrew's. Between the marine biologists of the North and South there is something of a spirit of rivalry, the result being that each school is inclined to ignore, more or less, the work of the other—or, at any rate, not overburden it with praise. If, however, Mr. Cunningham's volume and the present one be considered together, we get a satisfactory account of the investigations into the life histories of British marine food fishes, each work supplying what the other lacks. When the important place which marine food fishes occupy in the daily food supply of the country is remembered, the general ignorance of the habits and development of the species of fish familiar to every housewife is somewhat surprising. In certain cases the proverb, "Where ignorance is bliss 'tis folly to be wise," may very well be applied; for the diet of some of our favourite food fishes is not of the daintiest character, and the natural appearance of others is so repulsive that unless it is disguised the sale would be seriously affected. However, it is not for science to consider the æsthetic tastes of an unreasoning public, and the volume under notice shows what a large amount of interesting information has been obtained with reference to the life histories of the fishes used for our sustenance. The first part is devoted to general remarks on pelagic eggs, and the various stages of development into the larval and then the adult forms of fishes. Following this is a semi-popular description of the structural development of teleosteans (bony fishes), and a chapter on the rate of growth of food fishes. This concludes Part I., the remainder of the volume being taken up with the life histories of the various species. We do not hesitate to say that these life histories will be found as valuable as they are interesting to all who are engaged in the fishing industry. Moreover, the professed naturalist will find that the chapters constitute a useful epitome of the present state of knowledge of the breeding habits, migrations, and transformations of the species described. The book is illustrated with numerous figures in the text, and twenty partly coloured plates. It is undoubtedly a valuable contribution to the literature of a subject the importance of which, both economically and scientifically, cannot be over-estimated.

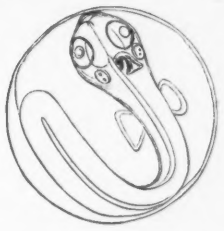


Egg of Cod, with Embryo. Lateral View.

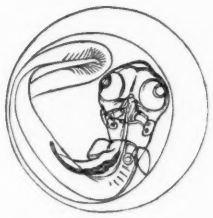
Embryo on Sixth Day. Lateral View.



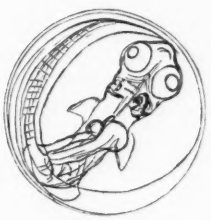
More Advanced Embryo on Sixth Day. Ventral View.



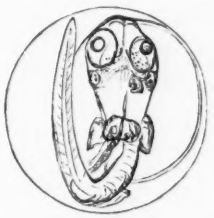
Embryo on Ninth Day. Nearly Dorsal View.



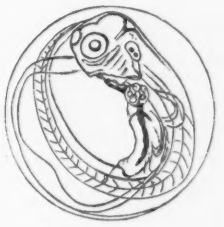
Advanced Embryo on Ninth Day.



Advanced Embryo. Dorsal View.



More Advanced Embryo. Dorsal View.



Embryo on Ninth Day. Nearly ready to hatch.

From "Life Histories of the British Marine Food Fishes."

*Bird Life.* By Frank M. Chapman. (New York: Appleton & Co.) Illustrated. Mr. Chapman is a well-known American ornithologist, and his present book is a model popular bird book; a model which writers of popular works on our own birds would do well to examine and copy. The author's plan, and the way in which this plan is carried out, are beyond praise. In direct but comprehensive language, he gives, in his introduction, a brief summary of a bird's place in nature and its relation to man; its evolution; the form and uses of its different parts; the purposes and changes of its plumage; its migrations; its song; its reproduction; and, finally, an excellent chapter on the "field study" of birds—how to identify them; how to learn their habits; and, above all, how to make observations of value and interest. We unhesitatingly pronounce this introduction as the best we have ever seen for the purpose of teaching the beginner, and opening the eyes of the very blindest to the value and importance of studying birds, and to the interest and healthy pleasure which that study will surely give. The introduction is followed by brief but good descriptions of the habits and forms of a number of the commoner American birds. The illustrations by Mr. Ernest Seton Thompson are very fine, and rival in excellence and exactness those of Mr. Thorburn. That Mr. Thompson is a true lover and keen observer of birds, as well as an artist, is evident, for there is life in nearly all his drawings.

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*Volcanoes of North America.* By Israel C. Russell. (Macmillan & Co.) Illustrated. 16s. net. We have here a book forming a popular reading lesson on the very interesting subject of volcanoes, the views advanced being in great part the result of direct observation, while the compiled portion is backed up by useful references to authoritative sources. One of the great problems of the geologist has been, in the past, and will continue to be in the future, the divination of the action of volcanoes. What is the process which results in the ejection of masses of lava competent to bury a great city like ancient Pompeii, and the simultaneous issue of enormous quantities of mixed gases sufficient to envelop a country? Some great internal force must be at work, but what that force is the leading theorists are not, as yet, entirely at one in determining. The volcanoes of the American continent form the subject matter for the greater portion of this book, although the Old World is not forgotten. Such a work will appeal to European readers, as much light is thrown on the origin and characteristics of the volcanoes of North America. A very instructive and picturesque chapter on "The Life History of a Volcano" is given at the end of the book, in which the author very lucidly conveys an idea of the building up of a volcano from its infancy, and its subsequent decline to its original state. Excellent examples of the solidified lava in the volcanic chimneys are figured—the central cones which have resisted waste and decay much more effectually than the softer beds of shale and sandstone with which they were surrounded, and now remain as conspicuous landmarks after the general surface has been disintegrated and swept away by natural forces. In a chapter on "Theoretical Considerations," Prof. Russell brings together practically all that is known about the anatomy, so to speak, of volcanoes, together with much that is purely speculative. While, however, the author's literary style is clear and his observational power keen, it seems to us that in the domain of suggestion he does not attain a very high level. When one considers the prominence of volcanoes as a feature of American scenery, the work before us does not by any means represent an exhaustive treatise on the subject; and one is inclined to think that some luxury in printing might have been sacrificed for the more than compensating equivalent of fuller information on a subject of such absorbing interest.

*A History and Description of the Modern Dogs of Great Britain and Ireland. The Terriers.* By Rawdon B. Lee. Illustrated. (Horace Cox.) 10s. 6d. This is a book which should be known and consulted by every owner of a good terrier. The author is the kennel editor of the *Field*, and he describes our favourite terriers with knowledge that has come from experience. The general characteristics, the working capacities, and the show points, are all clearly particularized; while biographical details of practically every important pedigree terrier are described with the zest that comes from close familiarity with the facts. Of all the terriers, the fox terrier has, undoubtedly, had the most admirers. It began to be popular about thirty years ago. For ten years or so the popularity of the breed was phenomenal, and, though the dog has partly gone out of favour, it is still held in high estimation by many dog lovers. And rightly is this so, for a good fox terrier is a pretty dog, as well as an efficient and intelligent one. Next to this breed we place the Irish terrier, which has made much progress in public opinion during the past fifteen or sixteen years. No Irish terrier has, however, ever reached the prices paid for the best fox terriers. Mr. Lee mentions an instance of two hundred and twenty pounds being offered for a couple of Irish terriers, but four hundred and seventy pounds has certainly been paid for a first-class fox terrier, and probably a higher figure has been reached in private dealings. In addition to these two breeds of terriers, thirteen other varieties are fully described. Every really good terrier seems to be mentioned; and every dog owner who possesses a terrier having prize points, or coming from a good stock, can refer to the book with confidence. The illustrations, drawn by Mr. Arthur Wardle, are among the best pictures of terriers that have ever come under our notice. Since 1894, when the first edition of the work appeared, the Kennel Club have passed the rule that dogs with their ears cropped cannot take prizes at shows held under their regulations. The ears of bull terriers, English white terriers, black and tan terriers, and toy terriers, are, therefore, shown in their natural state instead of cut in the manner represented in the original sketches.

*Astronomical Tables. Tables of Vernal Equinoxes and New Moons for 3555 Years.* By H. Grattan Guinness, D.D., F.R.A.S. (Hodder & Stoughton.) Dr. Grattan Guinness was led to have these tables computed in order to serve as an appendix to a theological work which he was preparing. But the value of the tables is not in the least restricted to their bearing upon the companion volume. The astronomer, historian, and chronologist, and all who are interested in chronological inquiries, will find these tables of the very highest utility. Practically they form a series of nearly complete almanacks from the year 1622 B.C. to 1934 A.D. The time of every new moon is given—expressed in civil time for the meridian of Jerusalem—and the date of every vernal equinox, and from the tables of Dominical letters supplied it is easy at once to supply the day of the week of any event. The accuracy of Dr. Guinness's work is amply guaranteed by a comparison with such tables as those of Oppolzer's "Canon of Eclipses," and by the opinion of such high authorities as Dr. Downing of the *Nautical Almanac;* Dr. Marth, the great computer, whose recent death is so great a loss to astronomy; and Dr. Dreyer, Director of the Armagh Observatory. The latter, after testing the tables by means of a number of rigorously computed eclipses, concludes that "these tables are therefore somewhat more accurate than those of Largeteau"—the tables usually employed by chronologists for calculating historical new moons—"and of course vastly more convenient, as they do not entail any calculation. . . Particularly to students of Oriental history they will be invaluable, as the moon is the clock-hand of Eastern nations." The tables are based on the luni-solar cycles of two thousand three hundred and one thousand and forty years respectively, discovered by the Swiss astronomer De Cheseaux about one hundred and fifty years ago. An addition of considerable value has been made to the tables by the indication after the year 1208 B.C. of the dates of all the lunar eclipses; and the only criticism that we have to make on this most laborious and valuable work is that it is a pity that those new moons which were coincident with partial, annular, or total solar eclipses were not indicated as such. The addition to the labour and cost of the work would have been trivial—the addition to its value great. Nevertheless, the debt which students owe to Dr. Guinness for the immense labour undertaken in the preparation of these tables, and for the great clearness with which they have been arranged and printed, is most considerable.

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